PLANT CELL BIOLOGY AND DEVELOPMENT

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Plant Cell Biology and Development

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Preface

This is the first volume of Plant Cell Biology and Development, which has an International Editorial Board. First of all, I would like to express my sincerest thanks to all colleagues who accepted my proposal to contribute and increase the scientific value of the publication series of our Laboratory. All members of the Editorial Board are worldwide recognized scientists. But for technical assistance two young university students working in my Laboratory were chosen. The List of Publications of the Laboratory and the Chronicle were also compiled by the younger generation. This is one aspect of the spirit of the Laboratory solving the generation problem and creating fruitful scientific activity by the energy of the youth and the experience of the adult generation.

Till this time Plant Cell Biology and Development was distributed to colleagues or libraries of the countries as follows: Albania, Algeria, Argentina, Armenia, Australia, Austria, Azerbaijan, Bangkok, Bangladesh, Belgium, Bohemia, Bolivia, Borneo, Brasil, Bulgaria, Burkina Faso, Burundi, Byelorussia, Cameron, Canada, Chile, China (P. R.), Columbia, Congo, Corea, Costa Rica, Croatia, Cuba, Denmark, Ecuador, Egypt, Esthonia, Ethiopia, Faroe Island, Finland, France, Gabon, Germany, Greece, Gruziya, Hong Kong, Iceland, India, Indonesia, Iraq, Ireland, Israel, Italy, Ivory Coast, Japan, Jordan, Jugoslavia, Kazakhstan, Kenya, Kirgizia. Lesotho, Libya, Lithuania, Madagascar, Malaysia, Malta, Mexico, Moldavia, Morocco, Myanmar, Nepal, The Netherlands, New Zealand, Niger, Nigeria, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Quatar, Roumania, Ruanda, Russia, El Salvador, Saudi Arabia, Slovakia, Slovenia, South Africa, Spain, Sudan, Sultanate Oman, Sweden, Switzerland, Syria, Tadzhikistan, Taiwan (ROC), Tanzania, Thailand, Togo, Tunisia, Turkey, Turkmenistan, Uganda, The Ukraine, Union of Burma, United Kingdom, Uruguay, U.S.A., Uzbekistan, Venezuela, Vietnam, Zaire and Zimbabwe.

Regarding the further volumes of Plant Cell Biology and Development will remain henceforward the publication series of the Laboratory and its contributors. This will also be scientific exchange and no commercial material. The printing and the distribution expenses depend on the Foundations Grants and other financial supports obtained by the members of the Laboratory. There are several colleagues who are interested in the publication in Plant Cell Biology and Development. Concerning this subject it is necessary to emphasize that papers are welcome by all colleagues who are any kind of contributors to our Laboratory. Because of financial problems we cannot offer any reprints but the authors can make photocopies of the papers. Colleagues who are non-contributors to the

Laboratory may also be publish their papers of any subject is in the scope of the multi-disciplinary aspect of our program, but taking into consideration the situation of the Laboratory, page charges will be requested. Till this time we have not requested and received any financial support from extra Hungarian funds. For the first time for the last number Prof. Dr. C. ALVAREZ RAMIS donation was much welcome for the Laboratory budget. If Libraries or Institutions can and want to contribute to the printing expenses of our publication, they can send a cheque to the J. A. University with the reservation that the sum can be only used for the printing expenses of Plant Cell Biology and Development.

And now we turn to a tradition of the Laboratory introduced last year. On the 21st August, the following persons were awarded with the Commemorative Medal of the Laboratory:

Prof. Dr. Á. PÁRDUTZ, head of the Electron Microscope Laboratory of the Institute of Biophysics of the Biological Center of the Hungarian Academy of Sciences. A very fruitful cooperation in the field of electron microscopical investigations of palynomorphs started at the end of the sixties and is to be felt even now. Several joint papers were published and are in preparation. We planned a long perspective cooperation between the two Laboratories. Prof. Dr. Á. PÁRDUTZ is always very helpful not only in the elaboration of the joint programs but in teaching students as well.

Prof. Dr. C. ALVAREZ RAMIS, Madrid, Spain is a worldwide recognized scientist in Paleobotany. She recognized also the necessity of the multidisciplinary research concepts in the field of Paleobotany. The scientific cooperation between our Laboratories started not a long time ago, but developed very quickly and is very productive. During her sojourn in 1995 in Szeged, she proposed me to organize a scientific or editorial commission for Plant Cell Biology and Development. I accepted with pleasure this suggestion. Further scientific cooperation is projected in the subject of the Upper Cretaceous palynomorphs of Spain and Hungary.

Prof. Dr. N. SOLÉ DE PORTA, Barcelona, Spain. Our scientific cooperation started in the sixties with a comparative study of the Hungarian and Columbian *Cicatricosisporites* form-species. In the last decades the cooperation and the contact have been regular. Joint papers were published in the subject of the uppermost Upper Cretaceous and are in progress comparing *angiosperm* pollen grains isolated from the Eocene sediments of Málaga in comparison with the Hungarian spore-pollen assemblages.

On the 21st August an exclusive reception was held in the Laboratory for students and colleagues working in the Laboratory. At this occasion two Laboratory Diplomas were handed to the following persons:

A. VÉR (middle-school professor at the Technical College of Forestry in Barcs, Hungary). She started her work in the Laboratory as a university student. She cooperated in joint scientific research and worked in the first place on the *Botryococcus* colonies of the oil shale of Hungary. Now as a middle-school professor she has re-started the scientific work in the Laboratory not only in the research of the *Botryococcus* but also in the study of high temperature effect on *angiosperm* pollen grains.

Dr. S. K. M. TRIPATHI Senior Scientific Officer of the Birbal Sahni Institute of Palaeobotany, Lucknow, India. He worked for two months in our Laboratory, contributed in a great part of a new joint research program on the biopolymer structure and symmetry of partially degraded colonies of *Botryococcus braunii* isolated from Hungarian oil shale samples. His activity was appreciated by all members of the Laboratory. He is the first foreign colleague to receive this Diploma.

Finally I would like to express my sincere thanks to the following institutions and persons for their financial support in the publication of this number:

to the Foundation of Grant OTKA 1/7 T 014692,

to Dr. Gy. TELEGDY, member of the Hungarian Academy of Sciences,

to the Foundation for the Science of the South Hungarian Plain,

to Prof. Dr. K. VARGA, Dean of the Faculty of Science, J. A. University,

to Dr. I. SZALAY Major and Dr. I. FARKAS Town-Councillor of the Local Government of Szeged.

Szeged, 30 December, 1996.

M. KEDVES
Head of the Laboratory

1. UPPER CRETACEOUS POLLEN GRAINS FROM EGYPT I.

M. KEDVES

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Abstract

The LM results of the spores of our material of investigation were published in 1995. This contribution deals with the taxonomical elaboration of the greatest part of the *gymnosperm* pollen grains, except the monosulcate forms. During our investigations specimens of the following form-genuses were revealed: *Callialasporites, Alisporites, Cupressacites, Balmeiopsis, Araucariacites, Classopollis, Corollina, Eucommiidites, Ephedripites, Steevesipollenites*. One form-genus (*Stoveripollenites*) with one species (*S. africanus*) and the following new form-species were described herein: *Cupressacites farafraensis, C. khargaensis, Ephedripites brenneri, E. ameromii, E. coetzeae, E. krempii, E. boltenhagenii, E. rakosii, E. jansoniusii, Steevesipollenites khargaensis, S. elsikii*. The new form-subspecies are as follows: *Araucariacites australis aegypticus, Ephedripites minimus aegypticus, E. winiae magna.*

Key words: Palynology, fossil, *Gymnospermatophyta*, Upper Cretaceous, Egypt.

Introduction

The publication of the systematic elaboration of the sporomorphs of the samples collected in Egypt started not long time ago (1995). After the monographic elaboration of the spores, the pollen grains will be described and published in consecutive series of publications. The chapter "Materials and Methods" will not be repeated again and again this may be found in the monograph of the spores (KEDVES 1995, p. 15). As regards the evaluation and the discussion of the taxonomical data, this is planned as a terminal part of this series.

Systematic descriptions

ANTETURMA: *POLLENITES* R. POTONIÉ 1931
TURMA: *SACCITES* ERDTMAN 1947
SUBTURMA: *MONOSACCITES* (CHITALEY 1951) R. POTONIÉ and KREMP 1954
INFRATURMA: *ALETESACCITI* LESCHIK 1955

Form-genus: *Callialasporites* DEV 1961

VENKATACHALA and KAR (1969) discussed in detail the morphology of these pollen grains (under the name *Applanopsis*). POCOCK (1968) in a discussion of the taxonomy of the "*Zonalapollenites* group" wrote the following; p. 640: "It therefore seems desirable to retain *Callialasporites* to encompass the morphologically well defined group for which it was erected." An important comparative table on the main distinguishing characters of the different species and forms of this genus was published by FILATOFF (1975), p. 83.

1. *Callialasporites dampieri* (BALME 1957) DEV 1961
(Plate 1.1., figs. 1,2)

Syn.: 1957 *Zonalapollenites dampieri* BALME, p. 32, pl. 8, figs. 88, 90.
1961 *Callialasporites dampieri* (BALME) DEV, p. 48, pl. 4, figs. 26,27.
1961 *Applanopsis dampieri* (BALME) DÖRING, p. 113, pl. 16, figs. 11–15.
1962 *Pflugipollenites dampieri* (BALME) POCOCK, p. 72, pl. 12, figs. 183,184.
1963 *Tsugaepollenites dampieri* (BALME) DETTMANN 1963, p. 100, pl. 24, figs. 1–5.

Description: Amb circular to elliptical, the surface is finely granulate, the zone (=bladder) is 5–7 μm wide and radially folded.

Diameter: 63 μm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent.

SUBTURMA: *DISACCITES* COOKSON 1947
INFRATURMA: *PINOSACCITI* (ERDTMAN 1947) R. POTONIÉ 1958

Form-genus: *Alisporites* DAUGHERTY 1941

1. *Alisporites* cf. *bilateralis* ROUSE 1959
(Plate 1.1., figs. 3,4)

Description: Surface of the pollen grain is granulate, the marginal crest 3–4 μm thick, the infratectal layer is alveolar with radially oriented structure elements. The tectum and the foot layer are very thin. Amb of the bladders are semicircular, surface scabrate, the outer alveolae are 2 μm, the inner 3–5 μm in diameter.

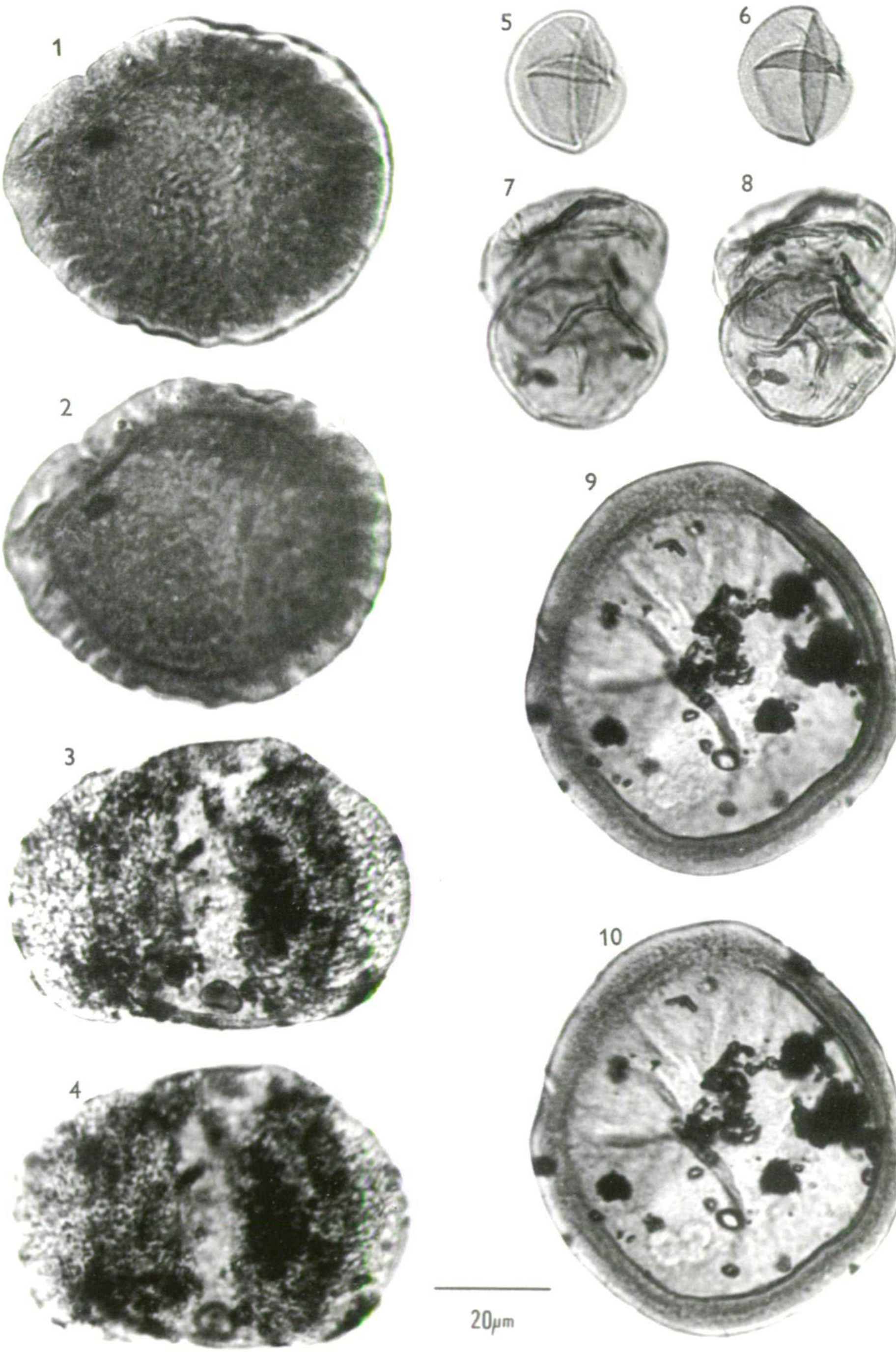
Total diameter: 67 μm.

Occurrence and frequency in the samples investigated from Egypt: Coniacian-Santonian: Abu Rauwash (70-1-7-1) infrequent.

TURMA: *ALETES* IBRAHIM 1933
SUBTURMA: *AZONALETES* (LUBER 1935) R. POTONIÉ and KREMP 1954
INFRATURMA: *PSILONAPITI* ERDTMAN 1947

SEM data concerning this pollen group from the Mesozoic of the Sahara were published by REYRE (1970).

Form-genus: *Cupressacites* BOLKHOVITINA 1956


1
2
3
4
5
6
7
8
9
10
20µm

Relatively small inaperturate, isodiametric pollen grains, without ligula (papillus). Surface ornamented with tiny elements.

1. *Cupressacites farafraensis* n. fsp.
(Plate 1.1., figs. 5,6)

Diagnosis: Amb originally circular, secondarily deformed, without germinal aperture. Surface punctate, finely granulate, the diameter of the ornamental elements are 0.2–0.3 μm. The pollen wall is 0.3–0.5 μm thick.

Diameter: 25 μm; 23–28 μm.

Holotype: Plate 1.1., figs. 5,6, slide: Farafra-6-2-2-4; cross-table number: 18.2/118.9.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: From the locality type.

Differential diagnosis: *C. cuspidataeformis* (ZAKLINSKAYA 1957) KRUTZSCH 1971 is larger than *C. farafraensis*. *Taxacites sahariensis* REYRE 1973 and *Cupressacites oxycedroides* REYRE 1973 are irregularly ornamented with orbiculi.

Botanical affinity: ?*Cupressaceae*.

Occurrence and frequency in the samples investigated from Egypt: Coniacian-Santonian: Abu Rauwash (70-1-7-2) common, Duwi common; Middle Campanian: Duwi infrequent; Upper Campanian: Duwi common; Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent, Farafra (11) infrequent, Kharga (1-39) common, Kharga (1-28) common; Maestrichtian, fm. indet.: Oweina (1) common.

2. *Cupressacites khargaensis* n. fsp.
(Plate 1.1., figs. 7,8)

Diagnosis: Amb circular or secondarily deformed. No germinal aperture or exine thinning was observable on these pollen grains. Surface scabrate or very finely rugulate, the size of the ornamental elements is 0.2–0.5 μm thick.

Diameter: 20 μm; 18–30 μm.

Holotype: Plate 1.1., figs. 7,8 – the superior specimen –, slide: Kharga-1-39; cross-table number: 13.4/104.9.

Locus typicus: Kharga, Maestrichtian, Nubia Sandstone.

Stratum typicum: clay.

Derivatio nominis: From Kharga the type locality.

Botanical affinity: ?*Cupressaceae*.

Plate 1.1.

1,2. *Callialasporites dampieri* (BALME 1957) DEV 1961, slide: Abu Minquar-4-3-5, cross-table number: 8.6/102.4.

3,4. *Alisporites* cf. *bilateralis* ROUSE 1959, slide: 70-1-7-1-7, cross-table number: 8.3/111.1.

5,6. *Cupressacites farafraensis* n. fsp., ?*Cupressaceae*, slide: Farafra-6-2-2-4, cross-table number: 18.2/118.9.

7,8. *Cupressacites khargaensis* n. fsp., ?*Cupressaceae*, slide: Kharga-1-39, cross-table number: 13.4/104.9.

9,10. *Balmeiopsis limbatus* (BALME 1957) ARCHANGELSKY 1977, slide: Duwi-L. C.-4, cross-table number: 12.1/101.5.

Differential diagnosis: The smaller size clearly separates this species from *C. insulipapillatus* (TREVISAN 1967) KRUTZSCH 1971 and *C. bockwitzensis* KRUTZSCH 1971. The exine of *C. baccataeformis* (ZAKLINSKAYA 1957) KRUTZSCH 1971 is thicker than that of the described new species.

Occurrence and frequency in the samples investigated from Egypt: Upper Campanian: Duwi common; Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent, Kharga (1-39) infrequent.

Form-genus: *Balmeiopsis* ARCHANGELSKY 1977

1. *Balmeiopsis limbatus* (BALME 1957) ARCHANGELSKY 1977
   (Plate 1.1., figs. 9,10)

Description: Amb circular, but in general deformed. Inaperturate pollen grains, but on both "pole" there are thinned zones of the exine. This, and the characteristic, sometimes zone-like, thick equatorial exine is the most important characteristic feature of this pollen grain. The thickest part of the exine is 2–6 μm thick. Structure is irregular and spongy by the light-microscope.

Diameter: 70 μm; 54–80 μm.

Remarks: TEM data from the specimens obtained from the lower part of the Nubia Sandstone (Jurassic) were published by KEDVES and PÁRDUTZ (1974), cf. KEDVES (1994). The outer spongy structure seems to be a primitive character. SEM studies on Mesozoic specimens of the Sahara were made by REYRE (1973).

Occurrence and frequency in the samples investigated from Egypt: Lower Campanian: Duwi common; Maestrichtian, Nubia Sandstone: Kharga (1-28) infrequent, Maestrichtian, fm. indet.: Oweina (1) infrequent.

INFRATURMA: *GRANULONAPITI* COOKSON 1947

Form-genus: *Araucariacites* COOKSON 1947

Inaperturate, relatively large isodiametric pollen grains, with granulate to baculate sculpture. The first SEM data concerning this genus (cf. *Araucariacites* COOKSON) were published by REYRE (1968).

1. *Araucariacites australis* COOKSON 1947 ex COUPER 1953 subfsp. *aegypticus* n. subfsp.
   (Plate 1.2., figs. 1,2)

Diagnosis: Amb circular, generally secondarily deformed, no exine thinning, or germinal aperture. Surface granulate, the size of the sculptural elements from 0.2 to 0.6 μm, rarely anastomosent. The exine is 1–1.6 μm thick and two layered; the outer is formed by the elements of the sculpture; the inner layer is probably the endexine.

Diameter: 90 μm; 80–110 μm.

Subfsp. type: Plate 1.2., figs. 1,2, slide: Farafra-6-2-2-2; cross-table number: 21.4/111.5.

Stratum typcium: clayey brown coal.

Derivatio nominis: From Egypt.

Differential diagnosis: The greater size separates this species from *A. australis* subfsp. *australis*, according to the dimensions reported in the original diagnosis of COOKSON (1947) is 39–93 μm. It seems that the re-examination of this very common pollen type is necessary.

Botanical affinity: *Araucariaceae*.

Occurrence and frequency in the samples investigated from Egypt: Lower Campanian: Duwi infrequent; Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Kharga (1-28) infrequent.

TEM data: KEDVES and PÁRDUTZ (1974), KEDVES (1994).

2. *Araucariacites hungaricus* DEÁK 1964, *Araucariaceae*
(Plate 1.2., figs. 3,4)

Description: Inaperturate pollen grains, amb circular, but secondarily deformed. Surface granular, the size of the sculptural elements are 0.2–0.3 μm. The exine is 0.7–1 μm thick; two layered; an outer, granular ectexine and an inner, probably lamellar endexine.

Diameter: 55 μm; 52–58 μm.

Remarks: Diameter after DEÁK's (1964) original description: 32–58 μm. The diameter of the grana was not given. TEM data from KEDVES and PÁRDUTZ (1974) (=*Araucariacites* fsp.$_{2}$, Fig. 4; 1-5), the lamellar ultrastructure of the endexine is well shown on the pictures, in particular on 4;2 and 4;5. (cf. KEDVES 1994).

Occurrence and frequency in the samples investigated from Egypt: Coniacian-Santonian: Duwi infrequent, Middle Campanian: Duwi infrequent, Upper Campanian: Duwi infrequent, Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent, Farafra (11) infrequent, Duwi Range (100) infrequent, Kharga (1-39) common, Kharga (1-28) common, Maestrichtian fm. indet.: Oweina (1) infrequent, Oweina (3) infrequent.

3. *Araucariacites balinkaense* KEDVES 1974, cf. *Araucariaceae*
(Plate 1.2., figs. 5,6)

Description: Inaperturate pollen grains, amb circular secondarily deformed. Surface finely granular or rugulate, the size of the ornamental elements varies from 0.2 to 0.4 μm. The exine is 0.8–1 μm thick, the two layers are not well discernible by light-microscope.

Diameter: 47 μm; 38–50 μm.

Remarks: The size and the diameter of the ornamental elements are a little smaller than those of the Hungarian ones, but these differences seems to be within the species variation. TEM data: KEDVES and PÁRDUTZ (1974), and KEDVES (1994).

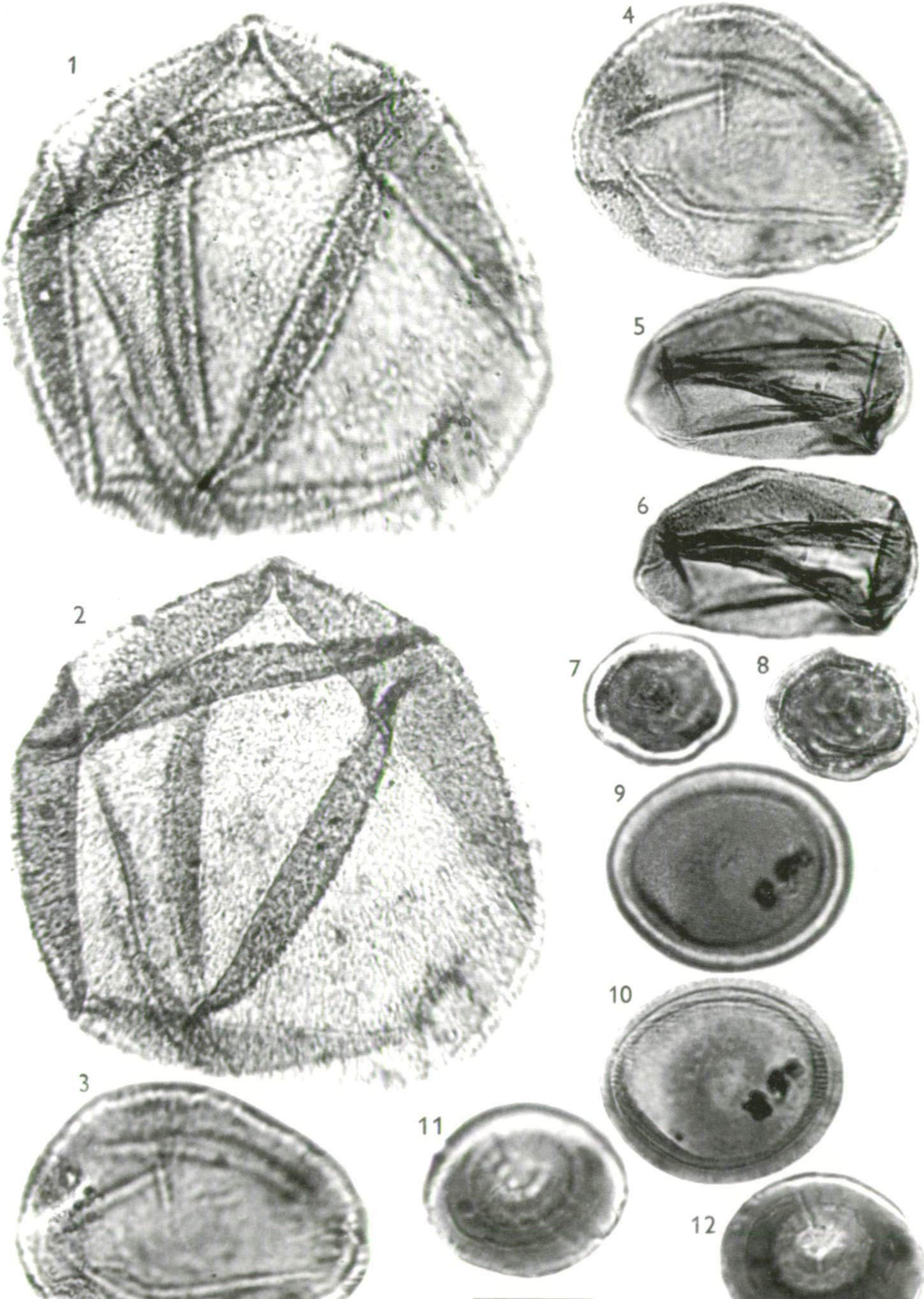
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Kharga (1-39) infrequent.

INFRATURMA: *CIRCUMPOLLES* (PFLUG 1953) KLAUS 1960

The classification of KLAUS (1960) is as follows:

1. *Singulipollenites*
   Praecirculina, Partisporites, Paracirculina, Discisporites, Duplicisporites
2. *Tetradopollenites*
   Circulina, Corollina

VENKATACHALA and GÓCZÁN (1964) introduced the *Operculati* subturma.


1
2
3
4
5
6
7
8
9
10
11
12
20µm

BOLTENHAGEN (1968) discussed the problems of these pollen grains and proposed a new classification:

Circumpolles

1. *Zonocolpates – Proxapertites*
2. *Zonates – Canalulates – Aporina, Classopollis, Granuloperculatipollis, Classoidites, Corollina*

MÉDUS (1969, 1970) discussed the *Circumpolles* group, and distinguished the following tribes: *Circulinae, Eocorollineae, Gemmulineae, Eucorollineae, Lobelineae, Paracorollineae, Echinulineae, Corollineae.*

Basic, taxonomically important publications: MALYAVKINA (1949), PFLUG (1953), COUPER (1958), KLAUS (1960) and POCOCK and JANSONIUS (1961). CHALONER (1962) described in detail the diagrammatic reconstruction of *Classopollis torosus*. Further new species are described by BURGER (1965). REYRE, KIESER and PUJOL (1970) discussed the stratigraphic and geographic importance of some species of this form-genus. PONS and BROUTIN (1978) established that the pollen grains of *Frenelopsis oligostomata* ROMARIZ 1946 emend. ALVIN 1977 are similar to *Classoidites glandis* AMEROM 1965. ALVIN, SPICER and WATSON (1978) described *Classopollis* type associated pollen grains from the macrofossil *Frenelopsis parceramosa* (FONTAINE) WATSON. The SEM sculpture was also published. AZEMA (1979) described *Classopollis alata* which was obtained from the macrofossil *Frenelopsis alata* (K. FEISTM.) KNOBLOCH. The SEM method was also used during these investigations. The first TEM data of this form-genus was published by PETTITT and CHALONER (1964). Monographical elaboration by KEDVES (1994). REYRE (1970) emphasized that without SEM data it is difficult to identify these pollen grains. Further SEM data by KEDVES (1976). SRIVASTAVA (1976) discussed in detail all of the problems of this form-genus and published additional important SEM data.

Form-genus: *Classopollis* PFLUG 1953

1. Cf. *Classopollis* fsp.
   (Plate 1.2., figs. 7,8)

Description: In polar view, amb circular, secondarily deformed. On the proximal pole, the triangular tetrad scar is well discernible by light-microscope; 5–8 μm in diameter. The equatorial exine is 4–5 μm thick, tectate; the tectum is relatively thick, the

Plate 1.2.

1,2. *Araucariacites australis* COOKSON 1947 ex COUPER 1953 subfsp. *aegypticus* n. subfsp., *Araucariaceae*, slide: Farafra-6-2-2-2, cross-table number: 21.4/111.5.

3,4. *Araucariacites hungaricus* DEÁK 1964, *Araucariaceae*, slide: Farafra-6-2-2-1, cross-table number: 7.6/103.8.

5,6. *Araucariacites balinkaense* KEDVES 1974, cf. *Araucariaceae*, slide: Kharga-1-39-1, cross-table number: 16.4/117.1.

7,8. Cf. *Classopollis* fsp., slide: Oweina-1-4, cross-table number: 11.3/107.7.

9,10. *Classopollis perplexus* BOLTENHAGEN 1973, slide: Abu Minquar-4-3-2, cross-table number: 11.3/103.8.

11,12. *Corollina* fsp., slide: Abu Minquar-4-3-5, cross-table number: 15.7/101.5.

infratectal layer in optical section is columellar but forms an intrareticulate structure, so it is essentially alveolar. A relatively thin foot layer and probably an endexine is under the infratectal layer.

Diameter: 26 µm.

Remarks: TEM investigations are necessary to determine the exact structure of these pollen grains, which is probably very complicated, as was demonstrated first by PETTITT and CHALONER (1964).

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, fm. indet.: Oweina (1) infrequent.

2. *Classopollis perplexus* BOLTENHAGEN 1973
(Plate 1.2., figs. 9,10)

Description: Amb elliptic. Surface punctate or scabrate. The cryptopore are not so characteristic. The exine is 3–4 µm thick, its structure is not well discernible by the optical microscope. The endostriae are characteristic and number is about 20, a little more than those of BOLTENHAGEN's (1973) specimens.

Diameter: 40 µm; 36–44 µm.

Occurrence and frequency in the samples investigated from Egypt: Coniacian-Santonian: Abu Rauwash (70-1-7-2) infrequent, Lower Campanian: Duwi dominant, Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent, Kharga (1-39) infrequent, Kharga (1-28) common, Maestrichtian fm. indet.: Oweina (1) common.

Form-genus: *Corollina* (MALYAVKINA 1949) VENKATACHALA and GÓCZÁN 1964

This is the "older type" which generally occurs in Triassic layers. Its structure is simple, without striate equatorial bands.

1. *Corollina* fsp.
(Plate 1.2., figs. 11,12)

Description: Amb circular or secondarily deformed. Surface generally smooth. The polar scar on both sides are characteristic; a triangular and, respectively, a circular exine thinning, 9–10 µm in diameter. The equatorial exine is very thick (7–10 µm) its structure is not well discernible by optical microscope.

Diameter: 35 µm.

Remarks: Similar to the pollen grains of JARDINÉ and MAGLOIRE (1965, pl. 5, figs. 12,20; *Classopollis classoides* PFLUG) from Albian layers of the Ivory Coast and Senegal. Our specimens are probably recycled from older Mesozoic (Triassic) deposits.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent.

TURMA: *PLICATES* (-*PLICATA* NAUMOVA 1937, 1939) R. POTONIÉ 1960
SUBTURMA: *PRAECOLPATES* R. POTONIÉ and KREMP 1954

Form-genus: *Eucommiidites* ERTDMAN 1948

HUGHES (1961) described *Eucommiidites troedssonii* and *E. delcourtii* which are pollen grains observed in the micropyle and pollen chamber of *Spermatites pettensis* HUGHES 1961. The latter is Lower Cretaceous in age. This also supports the *gymnospermous* origin of *Eucommiidites*. DOYLE, M. VAN CAMPO and LUGARDON (1975) discussed in detail the different concepts concerning these pollen grains. They also described the results of SEM and TEM analyses of *Eucommiidites* sp. from the Aptian or Lower Albian (Potomac Group) of Delaware City. The surface is smooth, except for minute depressions or foveolae. The TEM structure is as follows: tectum with foveolae, the infratectal layer is granular, and there is an endexine. Further TEM and SEM data were published by TREVISAN (1980).

1. *Eucommiidites couperi* ANDERSON 1960
(Plate 1.3., figs. 1–4)

Description: Amb ellipsoidal, with three asymmetrical furrows. The middle furrow flares out at its ends. Surface psilate-scabrate. The exine is 0.8–1.3 μm thick, the three layers of the ectexine are equal. The structure of the infratectal layer is not well discernible by light-microscope.

Polar axis: 23 μm; 22–31 μm.

Remarks: *Trifossapollenites ivoriensis* JARDINÉ and MAGLOIRE 1965 is smaller (17–25 μm). This species was found in the Albian-Aptian-Cenomanian layers of the Ivory Coast, and in the Aptian to Cenomanian of Senegal. *Trifossapollenites magloirae* JAN DU CHÊNE 1978 (in JAN DU CHÊNE, DE KLASZ and ARCHIBONG, 1978) from the Albian-Cenomanian layers of Senegal is similar to our specimens.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent, Kharga (1-39) common, Kharga (1-28) common, Maestrichtian, fm. indet.: Oweina (1) common.

SUBTURMA: *POLYPLICATES* ERDTMAN 1952

Form-genus: *Ephedripites* BOLKHOVITINA 1953 ex R. POTONIÉ 1958

KRUTZSCH (1961) contribution to the knowledge of the fossil *Ephedra* pollen grains is very important. Further information was given by PENKOVA (1973). TEM structures from recent *Ephedra* pollens were described by AFZELIUS (1956, 1957) and M. VAN CAMPO and LUGARDON (1973). The infratectal layer in the ridges is granular, and a lamellar endexine is under the ectexine. TREVISAN (1980) published the first SEM and TEM data on Lower Cretaceous *Ephedripites* pollen grains from Italy.

1a. *Ephedripites minimus* AMEROM 1965 subfsp. *minimus, Ephedraceae*
(Plate 1.3., figs. 5–8)

Description: Amb ellipsoidal but sharpened at their poles. Surface smooth. Maximal thickness of the exine is 0.8–1.2 μm. The number of the ridges is 11-13, generally 12. The basis of the ridges is 0.8 μm in width the furrows 0.5 μm.

Polar axis: 22 μm; 21–26 μm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent.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1b. *Ephedripites minimus* AMEROM 1965 subfsp. *aegypticus* n. subfsp.
(Plate 1.3., figs. 9–14)

Diagnosis: The specimens of this form-species are 18–20 μm size. The number of the ridges is in general 12, rarely 14.

Subfsp. type: Plate 1.3., figs. 9,10, slide: Farafra-6-2-2-8; cross-table number: 20.2/109.3.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: From Egypt.

Differential diagnosis: The smaller size distinguish well this taxon from the typical forms of this form-species.

Botanical affinity: *Ephedraceae.*

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) common.

Plate 1.3.

1,2. *Eucommiidites couperi* ANDERSON 1960, slide: Abu Minquar-4-3-6, cross-table number: 5.8/113.3.

3,4. *Eucommiidites couperi* ANDERSON 1960, slide: Abu Minquar-4-3-5, cross-table number: 9.3/110.7.

5,6. *Ephedripites minimus* AMEROM 1965 subfsp. *minimus, Ephedraceae*, slide: Farafra-6-2-2-3, cross-table number: 18.4/118.2.

7,8. *Ephedripites minimus* AMEROM 1965 subfsp. *minimus, Ephedraceae*, slide: Farafra-6-2-2-1, cross-table number: 16.2/109.2.

9,10. *Ephedripites minimus* AMEROM 1965 subfsp. *aegypticus* n. subfsp., *Ephedraceae*, slide: Farafra-6-2-2-8, cross-table number: 20.2/109.3.

11,12. *Ephedripites minimus* AMEROM 1965 subfsp. *aegypticus* n. subfsp., *Ephedraceae*, slide: Farafra-6-2-2-3, cross-table number: 11.2/116.5.

13,14. *Ephedripites minimus* AMEROM 1965 subfsp. *aegypticus* n. subfsp., *Ephedraceae*, slide: Farafra-6-2-2-7, cross-table number: 18.0/120.0.

15,16. *Ephedripites viesenensis* KRUTZSCH 1961, *Ephedraceae*, slide: Farafra-6-2-2-9, cross-table number: 20.9/111.4.

17,18. *Ephedripites viesenensis* KRUTZSCH 1961, *Ephedraceae*, slide: Abu Minquar-4-3-2, cross-table number: 10.9/117.1.

19,20. *Ephedripites brenneri* n. fsp., *Ephedraceae*, slide: Farafra-6-2-2-7, cross-table number: 6.4/102.9.

21,22. *Ephedripites brenneri* n. fsp., *Ephedraceae*, slide: Farafra-6-2-2-5, cross-table number: 20.8/119.1.

23,24. *Ephedripites ameromii* n. fsp., *Ephedraceae*, slide: Farafra-6-2-2-3, cross-table number: 4.5/114.4.

25,26. *Ephedripites ameromii* n. fsp., *Ephedraceae*, slide: Farafra-6-2-1-8, cross-table number: 20.1/106.9.

27,28. *Ephedripites coetzeae* n. fsp., *Ephedraceae*, slide: Abu Minquar-4-3-10, cross-table number: 5.6/110.5.

29,30. *Ephedripites coetzeae* n. fsp., *Ephedraceae*, slide: Abu Minquar-4-3-2, cross-table number: 9.4/109.8.

31,32. *Ephedripites virginianensis* BRENNER 1963, *Ephedraceae*, slide: Farafra-6-2-1-8, cross-table number: 7.6/112.6.

33,34. *Ephedripites virginianensis* BRENNER 1963, *Ephedraceae*, slide: Farafra-6-2-1-9, cross-table number: 15.7/105.8.

35,36. *Ephedripites krempii* n. fsp., *Ephedraceae*, slide: Abu Minquar-4-3-8, cross-table number: 8.2/104.7.

37,38. *Ephedripites krempii* n. fsp., *Ephedraceae*, slide: Kharga-1-39-4, cross-table number: 20.1/120.5.

39,40. *Ephedripites crassoides* KRUTZSCH 1961, *Ephedraceae*, slide: Farafra-6-2-2-12, cross-table number: 9.8/109.3.

2. *Ephedripites viesenensis* KRUTZSCH 1961, *Ephedraceae*
(Plate 1.3., figs. 15–18)

Description: Amb ellipsoidal, slightly sharpened at the poles. Surface smooth, or finely scabrate. The exine is 0.8–1.2 μm thick. The number of the ridges is 12–15, generally 14. Width of the ridge base is 1.2–1.3 μm, those of the furrows 0.7 μm.

Polar axis: 28 μm; 25–40 μm.

Remarks: The specimens of Egypt are larger than those of Viesen. There is some similarity with *E. dudarensis* DEÁK 1964, but this species has only 6–8 ridges, which is a very distinctive and characteristic feature.

Occurrence and frequency in the samples investigated from Egypt: Lower Campanian: Duwi infrequent, Maestrichtian, Duwi infrequent, Maestrichtian, Nubia Sandstone: Farafra (6-2-2) common, Farafra (6-2-1) infrequent, Farafra (11) infrequent, Abu Minquar (4-3) infrequent, Kharga (1-39) infrequent.

3. *Ephedripites brenneri* n. fsp.
(Plate 1.3., figs. 19–22)

Diagnosis: Ellipsoidal pollen grains with sharpened poles. The outer exine layer often separate from the inner ones. Surface is smooth, the exine is 1.2–1.6 μm thick. The number of the ridges is 14–16, in general 16. The width of the ridges is 0.7–1.1 μm, the furrows are 0.5–0.7 μm in width.

Polar axis: 25 μm; 20–36 μm.

Holotype: Plate 1.3., figs. 19,20, slide: Farafra-6-2-2-7; cross-table number: 6.4/102.9.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: In honour of Dr. G. BRENNER, excellent investigator of the Cretaceous sporomorphs.

Differential diagnosis: *E. chaloneri* BRENNER 1968 has 6–8 alternating ridges and furrows.

Botanical affinity: *Ephedraceae.*

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Abu Minquar (4-3) infrequent.

4. *Ephedripites ameromii* n. fsp.
(Plate 1.3., figs. 23–26)

Diagnosis: Amb ellipsoidal, the poles are slightly sharpened, sometimes the outer exine layer is separated from the inner ones. The surface is smooth. The exine is 0.8–1 μm thick on the sides, and 1.3–2 μm on the apices. The number of the ridges is 16–18, generally 18. The width of the ridges is 0.8 μm, the furrows up to 1 μm. In several specimen there are small nodules on the ridges near the poles, but this is not a characteristic feature of this form-species.

Polar axis: 35 μm; 31–45 μm.

Holotype: Plate 1.3., figs. 23,24, slide: Farafra-6-2-2-3, cross-table number: 4.5/114.4.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.
Derivatio nominis: In honour of Dr. VAN H. W. J. AMEROM.
Differential diagnosis: *E. treplinensis* KRUTZSCH 1961 is 36 µm long and has 12 ridges, *E. winiae* AMEROM 1965 is 42–51 µm long and is therefore larger than our new species. It also has more ridges, with total about 30 in number.
Botanical affinity: *Ephedraceae*.
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent, Abu Minquar (4-3) infrequent.

5. *Ephedripites coetzeae* n. fsp.
(Plate 1.3., figs. 27–30)

Diagnosis: Amb narrow, ellipsoidal. Surface smooth, the exine is 1 µm thick at the poles and on the sides. The number of the ridges is 11–14, generally 12. The width of the ridges is 1.2–1.4 µm, those of the furrows are 1–1.6 µm.
Polar axis: 42 µm; 34–43 µm.
Holotype: Plate 1.3., figs. 27,28, slide: Abu Minquar-4-3-10, cross-table number: 5.6/110.5.
Locus typicus: Abu Minquar, Maestrichtian, Nubia Sandstone.
Stratum typicum: coaly clay.
Derivatio nominis: In honour of Dr. J. A. COETZEE.
Differential diagnosis: The described new fsp. is larger, than *E. treplinensis* KRUTZSCH 1961. The larger size and the number of ridges clearly separate this species from *E. ameromii* n. fsp. The ridge number also distinguishes this species from *E. virginianensis* BRENNER 1963.
Botanical affinity: *Ephedraceae*.
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent, Kharga (1-39) infrequent.

6. *Ephedripites virginianensis* BRENNER 1963, *Ephedraceae*
(Plate 1.3., figs. 31-34)

Description: Amb ellipsoidal, with only slightly sharpened poles. Surface smooth or scabrate. The exine is 1.2–1.4 µm thick on the sides, and 1.5–2 µm on the poles. The number of the ridges is 14, the width of the ridges is 1.2–1.5 µm, the furrows are 0.5–0.7 µm in width.
Polar axis: 42 µm; 35–45 µm.
Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent.

7. *Ephedripites krempii* n. fsp.
(Plate 1.3., figs. 35–38)

Diagnosis: Amb ellipsoidal, poles slightly sharpened. Surface smooth or scabrate. The exine is 1–1.6 µm thick. The number of the ridges is 7–8, generally 8. The sides are 0.8–1.2 µm, the furrows, 2–3.5 µm wide.

Polar axis: 39 µm; 34–44 µm.

Holotype: Plate 1.3., figs. 35,36, slide: Abu Minquar-4-3-8, cross-table number: 8.2/104.7.

Locus typicus: Abu Minquar, Maestrichtian, Nubia Sandstone.

Stratum typicum: coaly clay.

Derivatio nominis: In memoriam of Prof. Dr. G. O. W. KREMP, excellent investigator of the fossil sporomorphs.

Differential diagnosis: *E. wolkenbergensis* KRUTZSCH 1961 is 40–42 µm long, with 10–12 ridges. *E. virginianensis* BRENNER 1963 is 35–45 µm long, with generally about 14 ridges.

Botanical affinity: *Ephedraceae.*

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-1) infrequent, Abu Minquar (4-3) infrequent, Kharga (1-39) infrequent.

8. *Ephedripites crassoides* KRUTZSCH 1961, *Ephedraceae*
(Plate 1.3., figs. 39,40)

Description: Amb ellipsoidal with slightly sharpened poles. Surface scabrate. Exine is 2–2.3 µm thick. The number of the ridges is 10–12. Width of the ridges is 0.7–1.3 µm, those of the furrows, 1–2.5 µm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent, Farafra (11) infrequent, Abu Minquar (4-3) infrequent, Maestrichtian fm. indet.: Oweina (1) infrequent.

9. *Ephedripites boltenhagenii* n. fsp.
(Plate 1.4., figs. 1–4)

Diagnosis: Amb ellipsoidal with sharpened poles. Surface smooth or scabrate. The exine is 1 µm thick on the sides and 2–2.5 µm on the poles. The number of the ridges is 14–15, generally, 16. The ridges are 0.7–1.3 µm, the furrows, 0.4–0.6 µm in width.

Polar axis: 46 µm; 32–48 µm.

Holotype: Plate 1.4., figs. 1,2, slide: Farafra-6-2-2-1, cross-table number: 11.8/100.6.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: In honour of Dr. E. BOLTENHAGEN, excellent investigator of the Cretaceous sporomorphs of Equatorial Africa.

Differential diagnosis: *E. frankfurtensis* KRUTZSCH 1961 is 37 µm long, with 17 ridges, *E. montanaensis* BRENNER 1968 is 52/57/62 µm long, with 14–18 ridges. Therefore it is the larger size, which separates this species from *E. boltenhagenii* n. fsp.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent, Farafra (11) infrequent, Abu Minquar (4-3) infrequent, Kharga (1-39) infrequent.

10. *Ephedripites multicostatus* BRENNER 1963, *Ephedraceae*
(Plate 1.4., figs. 5–10)

Description: Amb ellipsoidal, with sharpened poles. Surface scabrate. The exine is 0.5–0.8 μm on the sides and 1.6–2 μm on the poles. The number of the ridges is 19–22, generally 20. The width of the ridges is 0.5–1.2 μm, those of the furrows, 0.6–1.4 μm.

Polar axis: 38 μm; 33–48 μm.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent, Abu Minquar (4-3) infrequent.

11. *Ephedripites regularis* VAN HOEKEN-KLINKENBERG 1964, *Ephedraceae, Ephedra* (Plate 1.4., figs. 11–14)

Description: Amb ellipsoidal. Surface scabrate or finely punctate. The exine is about 1 μm thick on the sides and 1.7–2.5 μm at the poles. The number of the ridges is 14–16. The ridges are generally 1 μm in width, the furrows, 1.6–2 μm.

Polar axis: 56 μm; 50–60 μm.

Remarks: VAN HOEKEN-KLINKENBERG (1964) described this species from the Maestrichtian layers of Nigeria. The number of the ridges was not indicated in the description but from her photomicrographs it appears to be about 14.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent.

12. *Ephedripites rakosii* n. fsp. (Plate 1.4., figs. 15–18)

Diagnosis: Amb ellipsoidal, with sharpened poles. Surface scabrate. The exine is 1–1.5 μm thick on the sides, and 2–3 μm at the poles. The number of the ridges is 14–18, generally 16. Width of the ridges is 0.5–2 μm and those of the furrows 1–1.5 μm.

Polar axis: 54 μm; 41–56 μm.

Holotype: Plate 1.4., figs. 15,16, slide: Farafra-6-2-2-8, cross-table number: 10.7/110.8.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: In honour of Dr. L. RÁKOSI excellent investigator of the Hungarian paleogene sporomorphs.

Differential diagnosis: *E. schoenevaldensis* KRUTZSCH 1961 is 50 μm long, with 10 ridges, *E. procerus* BRENNER 1968 is 79 μm long, with 14–18 ridges, *E. caichigiiensis* VOLKHEIMER and QUATTROCHIO 1975 (syn.: *Equisetosporites caichigiiensis* n. sp., p. 236, pl. 10, figs. 15,16, pl. 11, figs. 1–4) is 32–68 μm in size, *E. nobilis* (SRIVASTAVA 1968) n. comb. (syn.: *Gnetaceaepollenites nobilis* n. sp., p. 214, fig. 1) has 10–12 ridges, and the size is a little larger.

Botanical affinity: *Ephedraceae*.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent, Kharga (1-39) infrequent.

13. *Ephedripites jansoniusii* n. fsp. (Plate 1.4., figs. 19–22)

Diagnosis: Amb ellipsoidal, with sharpened poles. Surface smooth or scabrate. The exine is 1–1.3 μm thick on the sides and 2.5–3 μm on the poles. The number of the


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ridges is 26–31, generally 30,31. The width of the ridges is 1–1.6 μm, those of the furrows are 0.3–0.6 μm.

Polar axis: 48 μm; 40–57 μm.

Holotype: Plate 1.4., figs. 19,20, slide: Farafra-6-2-2-5, cross-table number: 15.6/102.9.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Stratum typicum: clayey brown coal.

Derivatio nominis: In honour of Dr. J. JANSONIUS.

Differential diagnosis: The number of the furrows (which is higher) separates this form-species from *E. rakosii* n. fsp.

Botanical affinity: *Ephedraceae*.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent, Farafra (11) infrequent.

14. *Ephedripites winiae* AMEROM 1965 subfsp. *magna* n. subfsp.
(Plate 1.5., figs. 1,2)

Syn.:

1974 *Ephedripites* sp. (Type 276) BRENNER, pl. 3, fig. 12.

Diagnosis: Amb ellipsoidal. Surface smooth or scabrate. The exine is 0.9–1.2 μm on the sides and on the apices. The number of the ridges is 30–34, generally 32. The width of the ridges is 0.3–0.5 μm, those of the furrows are 0.3–0.4 μm.

Polar axis: 63 μm; 65–74 μm.

Subfsp. type: Plate 1.5., figs. 1,2, slide: Farafra-6-2-1-6, cross-table number: 6.3/114.6.

Locus typicus: Farafra, Maestrichtian, Nubia Sandstone.

Plate 1.4.

1,2. *Ephedripites boltenhagenii* n. fsp., *Ephedraceae*, slide: Farafra-6-2-2-1, cross-table number: 11.8/100.6.

3,4. *Ephedripites boltenhagenii* n. fsp., *Ephedraceae*, slide: Farafra-11-2, cross-table number: 18.6/109.8.

5,6. *Ephedripites multicostatus* BRENNER 1963, *Ephedraceae*, slide: Abu Minquar-4-3-10, cross-table number: 15.0/106.8.

7,8. *Ephedripites multicostatus* BRENNER 1963, *Ephedraceae*, slide: Farafra-6-2-2-12, cross-table number: 10.7/112.9.

9,10. *Ephedripites multicostatus* BRENNER 1963, *Ephedraceae*, slide: Farafra-6-2-1-5, cross-table number: 16.3/102.8.

11,12. *Ephedripites regularis* VAN HOEKEN-KLINKENBERG 1964, *Ephedraceae, Ephedra*, slide: Farafra-6-2-2-12, cross-table number: 4.3/112.8.

13,14. *Ephedripites regularis* VAN HOEKEN-KLINKENBERG 1964, *Ephedraceae, Ephedra*, slide: Farafra 6-2-2-1, cross-table number: 4.3/112.8.

15,16. *Ephedripites rakosii* n. fsp., *Ephedraceae*, slide: Farafra-6-2-2-8, cross-table number: 10.7/110.8.

17,18. *Ephedripites rakosii* n. fsp., *Ephedraceae*, slide: Farafra-6-2-2-10, cross-table number: 17.8/115.2.

19,20. *Ephedripites jansoniusii* n. fsp., *Ephedraceae*, slide: Farafra-6-2-2-5, cross-table number: 15.6/102.9.

21,22. *Ephedripites jansoniusii* n. fsp., *Ephedraceae*, slide: Farafra-6-2-2-2, cross-table number: 14.8/117.8.

Plate 1.5.

1,2. *Ephedripites winiae* AMEROM 1965 subfsp. *magna* n. subfsp., *Ephedraceae, Ephedra*, slide: Farafra--6-2-1-6, cross-table number: 6.3/114.6.
3,4. *Steevesipollenites binodosus* STOVER 1964, slide: Abu Minquar-4-3-3, cross-table number: 15.6/118.5.
5,6. *Steevesipollenites binodosus* STOVER 1964, slide: Kharga-1-39-5, cross-table number: 7.9/114.1.
7,8. *Steevesipollenites khargaensis* n. fsp., slide: Kharga-1-39-5, cross-table number: 12.7/102.3.
9,10. *Steevesipollenites khargaensis* n. fsp., slide: Abu Minquar-4-3-8, cross-table number: 9.6/102.6.
11,12. *Steevesipollenites elsikii* n. fsp., slide: Abu Minquar-4-3-2, cross-table number: 13.4/108.8.
13,14. *Stoveripollenites africanus* n. fgen. et fsp., slide: Abu Minquar-4-3-3, cross-table number: 18.8/102.5.

Stratum typicum: clay.

Derivatio nominis: From its relatively large size.

Differential diagnosis: *E. translucidus* DEÁK and COMBAZ 1967 has 30–35 ridges, which is the same as that in our pollen grains. However the size is only 45 μm and this represents the single characteristic feature for distinction.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Farafra (6-2-2) infrequent, Farafra (6-2-1) infrequent.

Form-genus: *Steevesipollenites* STOVER 1964

Polyplicate pollen grains with appendices on the poles. There are several transitional forms between *Ephedripites–Welwitschiapites* and *Steevesipollenites*. These pollen grains seem to be an important elements of the Mesozoic spore-pollen assemblages of the Southern Hemisphere.

1. *Steevesipollenites binodosus* STOVER 1964
(Plate 1.5., figs. 3–6)

Description: Amb ellipsoidal, with sharpened poles, and 2-3 μm long, and about 3.5 μm wide appendices. Surface scabrate. The number of the ridges is 12–18, one ridge is 1–2.5 μm wide, the furrows are 1.8–2.5 μm wide.

Polar axis, with appendices: 31 μm; 25–36 μm.

Occurrence and frequency in the samples investigated from Egypt: Lower Campanian: Duwi infrequent; Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent, Kharga (1-39) infrequent.

2. *Steevesipollenites khargaensis* n. fsp.
(Plate 1.5., figs. 7–10)

Diagnosis: Amb ellipsoidal, the polar thickenings (the appendices) are not prominent, these are 2.5-3 μm thick, and 5-7 μm wide. Surface scabrate, the exine is 1-1.5 μm thick on the sides. The number of the ridges is 10–18, their width is 1.5-2 μm, those of the furrows are 1-1.2 μm.

Polar axis, with thickenings: 45 μm; 38-49 μm.

Holotype: Plate 1.5., figs. 7,8, slide: Kharga-1-39-5, cross-table number: 12.7/102.3.

Locus typicus: Kharga, Maestrichtian, Nubia Sandstone.

Stratum typicum: clay.

Derivatio nominis: From Kharga, from the locality type.

Differential diagnosis: The larger size and the flat appendices separates this species from *S. binodosus* STOVER 1964.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent, Kharga (1-39) common, Kharga (1-28) infrequent.

3. *Steevesipollenites elsikii* n. fsp.
(Plate 1.5., figs. 11,12)

Diagnosis: Pollen grains with elongated form; 1.5-2 μm thick and 7-10 μm wide disc--forming thickenings on the poles. The exine is 0.8-1.3 μm thick on the sides. Surface psilate or scabrate. The number of the ridges is 10 about, its width is 1.3-2 μm; the furrows are generally 1.5 μm in width.

Polar axis with thickening: 35 μm; 30–35 μm.

Holotype: Plate 1.5., figs. 11,12, slide: Abu Minquar-4-3-2, cross-table number: 13.4/108.8.

Locus typicus: Abu Minquar, Maestrichtian, Nubia Sandstone.

Stratum typicum: coaly clay.

Derivatio nominis: In honour of Dr. W. C. ELSIK.

Differential diagnosis: The number of the ridges and the disc-forming appendices clearly distinguish this species from *S. khargaensis* n. fsp.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent.

Form-genus: *Stoveripollenites* n. fgen.

Form-genus type: *Stoveripollenites africanus* n. fgen. et fsp.

(Plate 1.5., figs. 13,14)

Diagnosis: Polyplicate ellipsoidal pollen grains. The ridges are sinuous. The valleys are much larger than the ridges.

Form-genus type: Plate 1.5., figs. 13,14, slide: Abu Minquar-4-3-3, cross-table number 18.8/102.5.

Locus typicus: Abu Minquar, Maestrichtian, Nubia Sandstone.

Stratum typicum: coaly clay.

Derivatio nominis: In honour to Dr. L. E. STOVER, excellent investigator of the Cretaceous sporomorphs.

Differential diagnosis: The ridges of *Singhia* SRIVASTAVA 1968 are bifurcating, the valleys of *Ephedripites* (*Spiralipites*) are narrow and in general narrower than the width of the muri.

1. *Stoveripollenites africanus* n. fsp.
(Plate 1.5., figs. 13,14)

Diagnosis: Amb ellipsoidal, the ridges are sinuous, their number is 8-10 μm. The ridges are 2 μm high and 2-2.7 μm in width, those of the furrows are 3-5 μm. Its surface is punctate or finely granulate.

Polar axis: 30 μm; 26-34 μm.

Holotype, locus typicus, stratum typicum, see previously.

Derivatio nominis: From Africa.

Occurrence and frequency in the samples investigated from Egypt: Maestrichtian, Nubia Sandstone: Abu Minquar (4-3) infrequent, Kharga (1-39) infrequent, Kharga (1-28) infrequent.

To be continued

Acknowledgements

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2. ETUDES PALYNOLOGIQUES DES COUCHES DU TERTIAIRE INFÉRIEUR DE LA RÉGION PARISIENNE. VIII.

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Sommaire

Avec cette partie, nous terminons la taxonomie des pollens des *Bréviaxes*. Les espèces des genres de forme suivants sont présentés: *Gallopollis, Anacolosidites, Smilacipites, Graminidites, Verrumonoporites, Milfordia, Restioniidites, Sparganiaceaepollenites, Pseudospinaepollis, Minutulipollis, Buxapollis, Juglanspollenites, Myriophyllumpollenites, Ulmoideipites, Alnipollenites,* et *Pentapollenites.*

Mots clés: Palynologie, Tertiaire inférieur, Région Parisienne, France.

Fgen.: *Gallopollis* GRUAS-CAVAGNETTO 1967

1a. *Gallopollis minimus* GRUAS-CAVAGNETTO 1967 subfsp. *minimus*
(Planche 2.1., fig. 1–10)

Présence: Thanétien, zone II: Anizy-le-Château; Sparnacien inférieur: Saint Léger-aux-Bois 21/6-6a; Sparnacien moyen: Chavot; Sparnacien supérieur: Guitrancourt B_1-32; Sparnacien, Facies Argiles des Flandres: Templeuve-en-Pévèle, B_1-25; Cuisien supérieur: Cuise-2.

1b. *Gallopollis minimus* GRUAS-CAVAGNETTO 1967 subfsp. *concaviformis* GRUAS-CAVAGNETTO 1967
(Planche 2.1., fig. 11–18)

Présence: Sparnacien inférieur: Arpenty B_1-118; Sparnacien moyen: Boulogne-la-Grasse 21/6-18, Sinceny 21/6-12, Sparnacien supérieur: Sinceny 21/6-7,8, 21/6-9,10,11.

Fgen.: *Anacolosidites* COOKSON et PIKE 1954

1. *Anacolosidites medius* KRUTZSCH 1959
(Planche 2.1., fig. 19–22)

Présence: Sparnacien supérieur: Neuilly.

Appartenance botanique probable: *Olacaceae, Anacolosa.*

2. *Anacolosidites pseudoefflatus* KRUTZSCH 1959
(Planche 2.1., fig. 23,24)

Présence: Sparnacien supérieur: Sinceny 21/6-7,8.

Appartenance botanique probable: *Olacaceae, Anacolosa.*

3. *Anacolosidites* fsp.
(Planche 2.1., fig. 25,26)

Présence: Thanétien, zone II: Rollot 21/6-16.

Fgen: *Smilacipites* WODEHOUSE 1933 emend. R. POTONIÉ 1960

1. *Smilacipites* fsp. A
(Planche 2.1., fig. 27–32)
Présence: Thanétien, zone III: Rollot 21/6-16; Sparnacien supérieur: Neuilly.
Appartenance botanique probable: *Smilacaceae.*
2. *Smilacipites* fsp. B
(Planche 2.1., fig. 33,34)
Présence: Cuisien supérieur: Fosses I–III.
Appartenance botanique probable: *Smilacaceae.*

Fgen.: *Graminidites* COOKSON 1947

1. *Graminidites* fsp.
(Planche 2.1., fig. 35,36)
Présence: Sparnacien moyen: Nointel.
Appartenance botanique probable: *Gramineae.*

Fgen.: *Verrumonoporites* PIERCE 1961

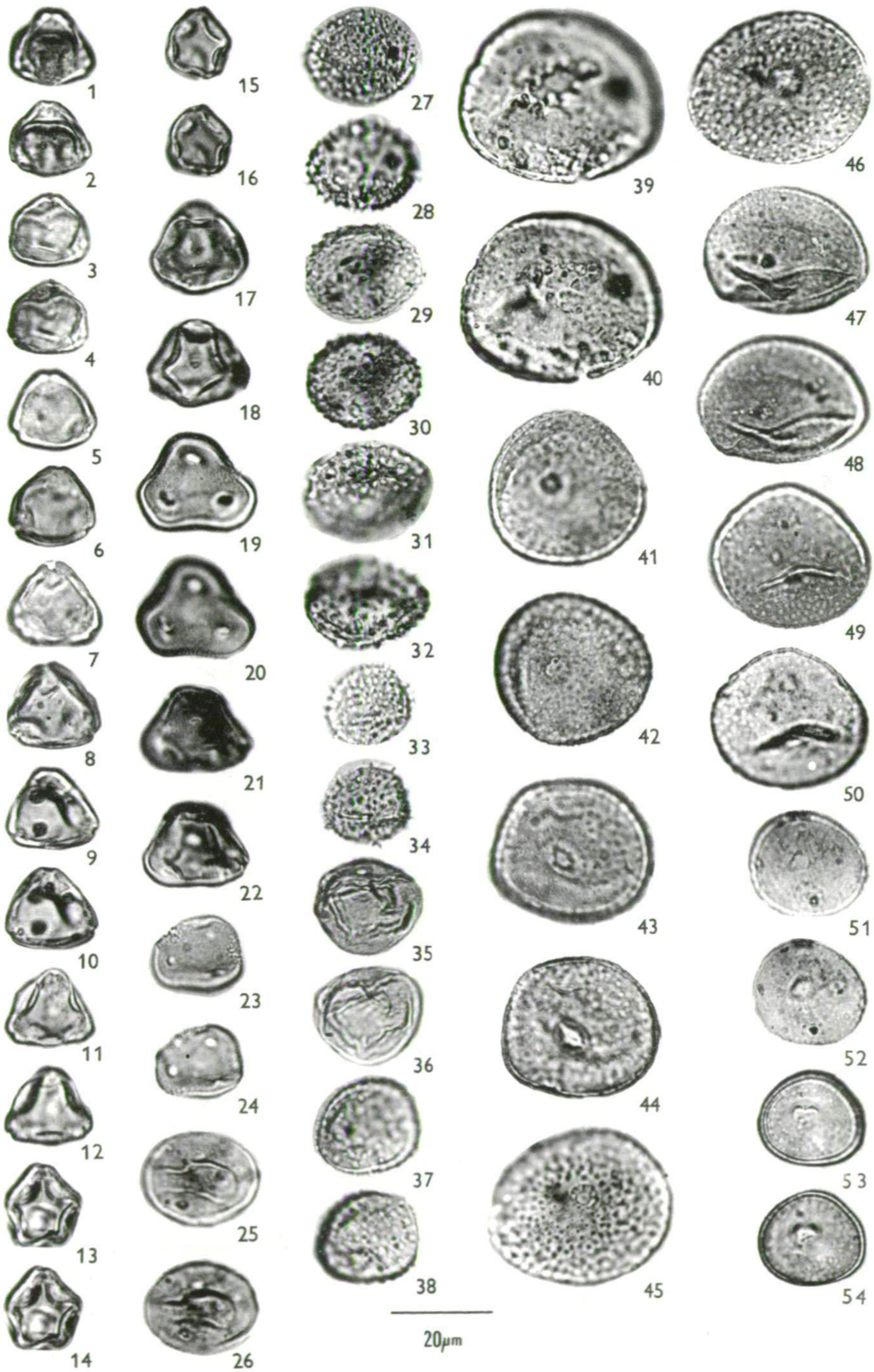
1. *Verrumonoporites* fsp.
(Planche 2.1., fig. 37,38)
Présence: Sparnacien moyen: Boulogne-la-Grasse 21/6-18.

Fgen.: *Milfordia* ERDTMAN 1960 emend. KRUTZSCH 1970

1. *Milfordia incerta* (THOMSON et PFLUG 1953) KRUTZSCH 1961
(Planche 2.1., fig. 39,40)
Présence: Sparnacien supérieur: Guitrancourt B_1-32.
Appartenance botanique probable: *Restionaceae.*

Fgen.: *Restioniidites* ELSIK 1968

1. *Restioniidites hungaricus* (KEDVES 1965) ELSIK 1968
(Planche 2.1., fig. 41–50)
Présence: Sparnacien moyen: Chavot; Sparnacien supérieur: Sinceny 21/6-7,8, 21/6-9,10,11; Cuisien supérieur: Troesnes I–III, Cuise-2; Lutétien supérieur: Paris, Austerlitz.
Appartenance botanique probable: *Restionaceae.*
Note. – L'ultrastructure de l'exine de cette espèce de forme a été publiée par KEDVES, STANLEY et ROJIK (1974).
2. *Restioniidites minimus* (KRUTZSCH 1970) KEDVES 1974
(Planche 2.1., fig. 51–54)
Présence: Thanétien, zone III: Rollot 21/6-16; Sparnacien supérieur: Guitrancourt B_1-32, Sinceny 21/6-7,8, 21/6-9,10,11; Sparnacien Facies Argiles des Flandres: Templeuve-en-Pévèle B_1-25; Cuisien supérieur: Troesnes I–III.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Appartenance botanique probable: *Restionaceae.*

Fgen.: *Sparganiaceaepollenites* THIERGART 1937

1. *Sparganiaceaepollenites polygonalis* THIERGART 1937
(Planche 2.2., fig. 1–8)
Présence: Sparnacien moyen: Boulogne-la-Grasse 21/6-18, Sinceny 21/6-12; Sparnacien supérieur: Sinceny 21/6-7,8.
Appartenance botanique probable: *Sparganiaceae.*

2. *Sparganiaceaepollenites cuvillieri* (GRUAS-CAVAGNETTO 1966) KRUTZSCH 1970
(Planche 2.2., fig. 9–14)
Présence: Sparnacien moyen: Boulogne-la-Grasse 21/6-18, Chavot, Sinceny 21/6-12; Sparnacien supérieur: Guitrancourt B_1-32, Sinceny 21/6-7,8.
Appartenance botanique probable: *Sparganiaceae.*

3. *Sparganiaceaepollenites reticulatus* (DOKTOROWICZ-HREBNICKA 1960) KRUTZSCH et VANHOORNE 1977
(Planche 2.2., fig. 15–18)

Planche 2.1.

1,2. *Gallopollis minimus* GRUAS-CAVAGNETTO 1967 subfsp. *minimus*, prep.: 21/6-62-2.
3,4. *Gallopollis minimus* GRUAS-CAVAGNETTO 1967 subfsp. *minimus*, prep.: Cuise 2/1.
5,6. *Gallopollis minimus* GRUAS-CAVAGNETTO 1967 subfsp. *minimus*, prep.: Chavot 1/1.
7,8. *Gallopollis minimus* GRUAS-CAVAGNETTO 1967 subfsp. *minimus*, prep.: Chavot 1/2.
9,10. *Gallopollis minimus* GRUAS-CAVAGNETTO 1967 subfsp. *minimus*, prep.: AT-4.
11,12. *Gallopollis minimus* GRUAS-CAVAGNETTO 1967 subfsp. *concaviformis* GRUAS-CAVAGNETTO 1967, prep.: 21/6-18.
13,14. *Gallopollis minimus* GRUAS-CAVAGNETTO 1967 subfsp. *concaviformis* GRUAS-CAVAGNETTO 1967, prep.: B_1-32-1.
15,16. *Gallopollis minimus* GRUAS-CAVAGNETTO 1967 subfsp. *concaviformis* GRUAS-CAVAGNETTO 1967, prep.: 21/6-18.
17,18. *Gallopollis minimus* GRUAS-CAVAGNETTO 1967 subfsp. *concaviformis* GRUAS-CAVAGNETTO 1967, prep.: 21/6-18.
19,20. *Anacolosidites medius* KRUTZSCH 1959, *Olacaceae, Anacolosa*, prep.: N-37-L-183-2c-118-1.
21,22. *Anacolosidites medius* KRUTZSCH 1959, *Olacaceae, Anacolosa*, prep.: N-37-L-183-2c-118-1.
23,24. *Anacolosidites pseudoefflatus* KRUTZSCH 1959, *Olacaceae, Anacolosa*, prep.: 21/6-7.
25,26. *Anacolosidites* fsp., *Olacaceae*, cf. *Anacolosa*, prep.: 21/6-16-1/1.
27,28. *Smilacipites* fsp. A, *Smilacaceae*, prep.: 21/6-18.
29,30. *Smilacipites* fsp. A, *Smilacaceae*, prep.: 21/6-16-1/6.
31,32. *Smilacipites* fsp. A, *Smilacaceae*, prep.: N-46-L-183-2c-118-2.
33,34. *Smilacipites* fsp. B, *Smilacaceae*, prep.: Fosses 3/1.
35,36. *Graminidites* fsp., *Gramineae*, prep.: Nointel-2/a.
37,38. *Verrumonoporites* fsp., prep.: 21/6-18.
39,40. *Milfordia incerta* (THOMSON et PFLUG 1953) KRUTZSCH 1961, *Restionaceae*, prep.: B_1-32-1.
41,42. *Restioniidites hungaricus* (KEDVES 1965) ELSIK 1968, *Restionaceae*, prep.: Austerlitz 1/1.
43,44. *Restioniidites hungaricus* (KEDVES 1965) ELSIK 1968, *Restionaceae*, prep.: Austerlitz 1/3.
45,46. *Restioniidites hungaricus* (KEDVES 1965) ELSIK 1968, *Restionaceae*, prep.: Cuise 2/2.
47,48. *Restioniidites hungaricus* (KEDVES 1965) ELSIK 1968, *Restionaceae*, prep.: Austerlitz 1/1.
49,50. *Restioniidites hungaricus* (KEDVES 1965) ELSIK 1968, *Restionaceae*, prep.: Austerlitz 1/1.
51,52. *Restioniidites minimus* (KRUTZSCH 1970) KEDVES 1974, *Restionaceae*, prep.: 21/6-16-1/8.
53,54. *Restioniidites minimus* (KRUTZSCH 1970) KEDVES 1974, *Restionaceae*, prep.: 21/6-7.

Présence: Sparnacien inférieur: Saint Léger-aux-Bois 21/6-6a; Sparnacien moyen: Boulogne-la-Grasse 21/6-18, Sinceny 21/6-12; Sparnacien supérieur: Neuilly-46; Sparnacien Facies Argiles des Flandres: Watten B_1-6.

Appartenance botanique probable: *Sparganiaceae.*

Fgen.: *Pseudospinaepollis* KRUTZSCH 1966

1. *Pseudospinaepollis pseudospinus* KRUTZSCH 1966
(Planche 2.2., fig. 19–22)

Présence: Sparnacien supérieur: Guitrancourt B_1-32, Neuilly-46, Neuilly-37; Cuisien supérieur: Troesnes I–III.

Appartenance botanique probable: *Thymelaeaceae.*

Fgen.: *Minutulipollis* KRUTZSCH 1966

1. *Minutulipollis* fsp.
(Planche 2.2., fig. 23,24)

Présence: Sparnacien inférieur: Saint Léger-aux-Bois, 21/6-6a.

Appartenance botanique probable: ?*Alismataceae.*

Fgen.: *Buxapollis* KRUTZSCH 1966

1. *Buxapollis* fsp. A
(Planche 2.2., fig. 25,26)

Présence: Thanétien, zone II: Anizy-le-Château; Sparnacien moyen: Sinceny 21/6-12.

Appartenance botanique probable: *Buxaceae.*

2. *Buxapollis* fsp. B
(Planche 2.2., fig. 27–30)

Présence: Thanétien, zone III: Rollot 21/6-16; Sparnacien moyen: Boulogne-la-Grasse 21/6-18.

Appartenance botanique probable: *Buxaceae.*

Fgen.: *Juglanspollenites* RAATZ 1937

1. *Juglanspollenites* fsp.
(Planche 2.2., fig. 31,32)

Présence: Sparnacien moyen: Sinceny 21/6-12.

Appartenance botanique probable: *Juglandaceae, Juglans.*

Fgen.: *Myriophyllumpollenites* E. NAGY 1969

Le genre de forme a été basé sur quelques exemplaires. Il nous semble qu'il faut ultérieurement complété et emendé la diagnose générique. GRUAS-CAVAGNETTO et PRAGLOWSKI (1977) apportent des documents très importants à la connaissance des pollens des *Haloragacées* fossiles, mais la question de la nomenclature n'a pas été abordée.

1. *Myriophyllumpollenites* fsp.
(Planche 2.2., fig. 33,34)
Présence: Cuisien supérieur: $Corcy_2$.
Appartenance botanique probable: *Haloragaceae*.

Fgen.: *Ulmoideipites* ANDERSON 1960

1. *Ulmoideipites tricostatus* ANDERSON 1960
(Planche 2.2., fig. 35–38)
Présence: Sparnacien moyen: Chavot; Sparnacien supérieur: Guitrancourt B_1-32; Cuisien supérieur: Troesnes I–III.
Appartenance botanique probable: *Ulmaceae*.

Fgen.: *Alnipollenites* R. POTONIÉ 1934

1. *Alnipollenites verus* R. POTONIÉ 1934
(Planche 2.2., fig. 39–42)
Présence: Thanétien, zone II: Anizy-le-Château; Thanétien, zone III: Rollot 21/6-16; Sparnacien inférieur: Saint Léger-aux-Bois 21/6-6a, 21/6-3; Sparnacien moyen: Chavot, Sinceny 21/6-12; Sparnacien supérieur: Nointel, Sinceny 21/6-7,8.
Appartenance botanique probable: *Betulaceae, Alnus*.

2. *Alnipollenites* fsp. A
(Planche 2.2., fig. 43,44)
Présence: Thanétien, zone II: Anizy-le-Château.
Appartenance botanique probable: *Betulaceae*.

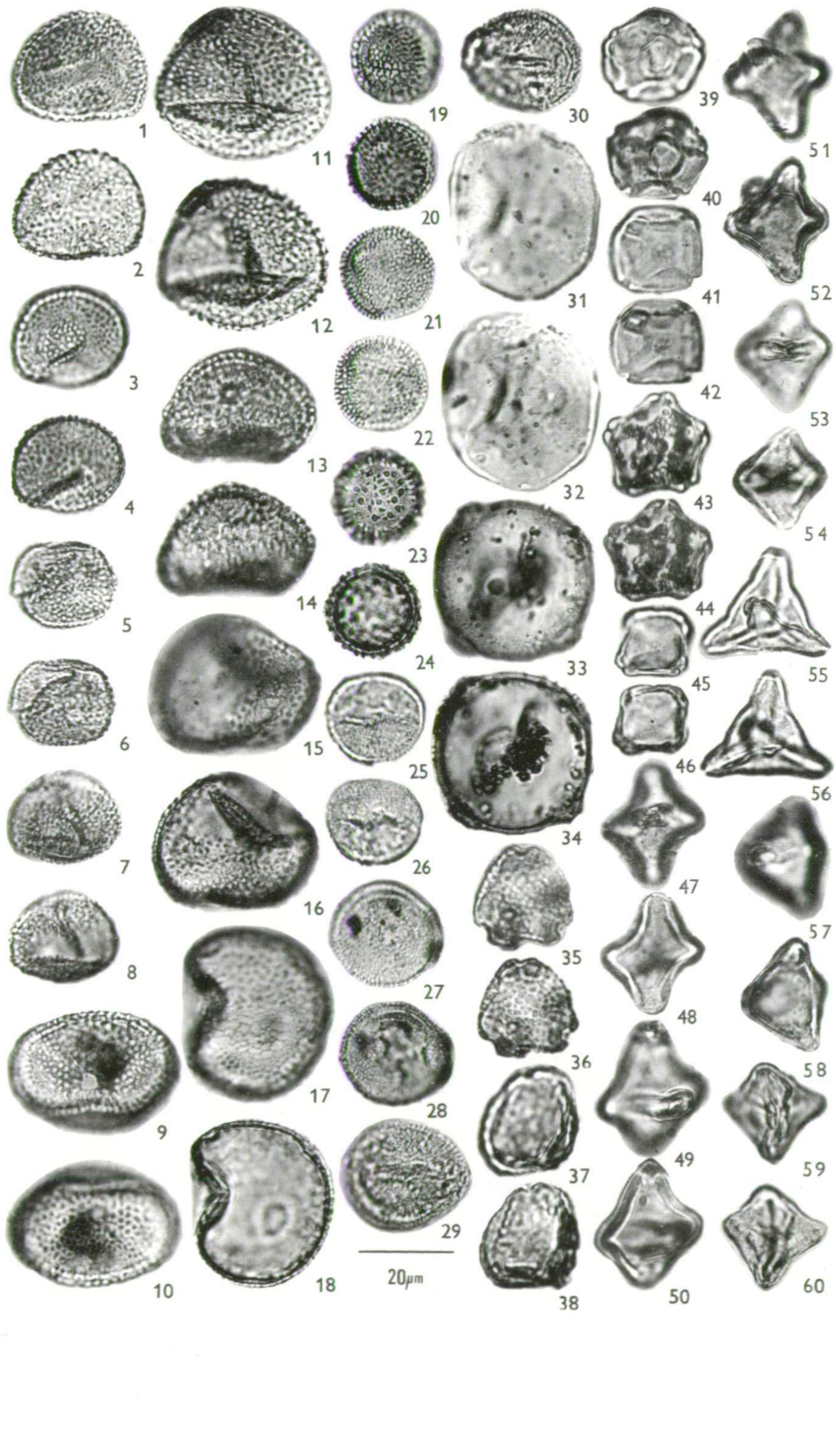
3. *Alnipollenites* fsp. B
(Planche 2.2., fig. 45,46)
Présence: Sparnacien inférieur: Arpenty B_1-118, Sparnacien supérieur: Sinceny 21/6-7,8.
Appartenance botanique probable: *Betulaceae*.

Fgen.: *Pentapollenites* KRUTZSCH 1962

Les résultats au MeT et MeB sur les pollens de ce genre de forme ont été publiés par KEDVES et STANLEY (1976), et la position taxonomique de ces grains de pollen a aussi été discutée. Ces pollens ne peuvent être rapportés à ceux du groupe *Triprojectacites/Aquilapollenites*.

1a. *Pentapollenites laevigatus* KRUTZSCH 1962 subfsp. *laevigatus*
(Planche 2.2., fig. 47–50)
Présence: Sparnacien moyen: Chavot; Sparnacien supérieur: Sinceny 21/6-7,8, 21/6-9,10,11; Lutétien supérieur: Paris, Austerlitz.
Appartenance botanique probable: *Elaeagnaceae*.

1b. *Pentapollenites laevigatus* KRUTZSCH 1962 subfsp. *laevigatoides* KRUTZSCH 1962
(Planche 2.2., fig. 51,52)
Présence: Lutétien supérieur: Paris, Austerlitz.
Appartenance botanique probable: *Elaeagnaceae*.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2. *Pentapollenites regulatius* KRUTZSCH 1962 subfsp. *concavus* KRUTZSCH 1962 (Planche 2.2., fig. 53,54)
Présence: Sparnacien supérieur: Neuilly-46.
Appartenance botanique probable: *Elaeagnaceae.*
3. *Pentapollenites triangulus* KRUTZSCH 1962 (Planche 2.2., fig. 55,56)
Présence: Thanétien, zone II: Anizy-le-Château; Sparnacien moyen: Sinceny 21/6-12; Sparnacien supérieur: Sinceny 21/6-7,8; Lutétien supérieur: Paris, Austerlitz.
Appartenance botanique probable: *Elaeagnaceae.*
4. *Pentapollenites pentangulus* KRUTZSCH 1962 subfsp. *pentangulus* (Planche 2.2., fig. 57,58)
Présence: Sparnacien supérieur: Guitrancourt B_I-32, Neuilly-46, Sinceny 21/6-7,8.
Appartenance botanique probable: *Elaeagnaceae.*

Planche 2.2.

1,2. *Sparganiaceaepollenites polygonalis* THIERGART 1938, *Sparganiaceae*, prep.: 21/6-12.
3,4. *Sparganiaceaepollenites polygonalis* THIERGART 1938, *Sparganiaceae*, prep.: 21/6-7.
5,6. *Sparganiaceaepollenites polygonalis* THIERGART 1938, *Sparganiaceae*, prep.: 21/6-12.
7,8. *Sparganiaceaepollenites polygonalis* THIERGART 1938, *Sparganiaceae*, prep.: 21/6-12.
9,10. *Sparganiaceaepollenites cuvillieri* (GRUAS-CAVAGNETTO 1966) KRUTZSCH 1970, *Sparganiaceae*, prep.: Chavot 1/1.
11,12. *Sparganiaceaepollenites cuvillieri* (GRUAS-CAVAGNETTO 1966) KRUTZSCH 1970, *Sparganiaceae*, prep.: 21/6-12.
13,14. *Sparganiaceaepollenites cuvillieri* (GRUAS-CAVAGNETTO 1966) KRUTZSCH 1970, *Sparganiaceae*, prep.: 21/6-18.
15,16. *Sparganiaceaepollenites reticulatus* (DOKTOROWICZ-HREBNICKA 1960) KRUTZSCH et VANHOORNE 1977, *Sparganiaceae*, prep.: N-46-L-183-2.
17,18. *Sparganiaceaepollenites reticulatus* (DOKTOROWICZ-HREBNICKA 1960) KRUTZSCH et VANHOORNE 1977, *Sparganiaceae*, prep.: Chavot 1/1.
19,20. *Pseudospinaepollis pseudospinus* KRUTZSCH 1966, *Thymelaeaceae*, prep.: Troesnes-III/2.
21,22. *Pseudospinaepollis pseudospinus* KRUTZSCH 1966, *Thymelaeaceae*, prep.: B_I-32-1.
23,24. *Minutulipollis* fsp., ?*Alismataceae*, prep.: 21/6-6a-7.
25,26. *Buxapollis* fsp. A, *Buxaceae*, prep.: 21/6-12.
27,28. *Buxapollis* fsp. B, *Buxaceae*, prep.: 21/6-16-1/1.
29,30. *Buxapollis* fsp. B, *Buxaceae*, prep.: 21/6-18.
31,32. *Juglanspollenites* fsp., *Juglandaceae*, *Juglans*, prep.: 21/6-12.
33,34. *Myriophyllumpollenites* fsp., *Haloragaceae*, prep.: Corcy-2.
35,36. *Ulmoideipites tricostatus* ANDERSON 1960, *Ulmaceae*, prep.: Troesnes-III/1.
37,38. *Ulmoideipites tricostatus* ANDERSON 1960, *Ulmaceae*, prep.: Troesnes-III/7.
39,40. *Alnipollenites verus* POTONIÉ 1934, *Betulaceae*, *Alnus*, prep.: 21/6-16-1/b.
41,42. *Alnipollenites verus* POTONIÉ 1934, *Betulaceae*, *Alnus*, prep.: 21/6-16-1/1.
43,44. *Alnipollenites* fsp. A, *Betulaceae*, prep.: AT-14.
45,46. *Alnipollenites* fsp. B, *Betulaceae*, prep.: 21/6-7.
47,48. *Pentapollenites laevigatus* KRUTZSCH 1962 subfsp. *laevigatus*, *Elaeagnaceae*, prep.: Chavot 1/1.
49,50. *Pentapollenites laevigatus* KRUTZSCH 1962 subfsp. *laevigatus*, *Elaeagnaceae*, prep.: Chavot 1/1.
51,52. *Pentapollenites laevigatus* KRUTZSCH 1962 subfsp. *laevigatoides* KRUTZSCH 1962, *Elaeagnaceae*, prep.: Austerlitz 1/2.
53,54. *Pentapollenites regulatius* KRUTZSCH 1962 subfsp. *concavus* KRUTZSCH 1962, *Elaeagnaceae*, prep.: N-46-L-183-2c-118-2.
55,56. *Pentapollenites triangulus* KRUTZSCH 1962, *Elaeagnaceae*, prep.: 21/6-7.
57,58. *Pentapollenites pentangulus* KRUTZSCH 1962 subfsp. *pentangulus*, *Elaeagnaceae*, prep.: 21/6-7.
59,60. *Pentapollenites semistriatus* KRUTZSCH 1962, *Elaeagnaceae*, prep.: 21/6-18.

5. *Pentapollenites semistriatus* KRUTZSCH 1962
(Planche 2.2., fig. 59,60)
Présence: Thanétien, zone II: Anizy-le-Château; Sparnacien moyen: Boulogne-la-Grasse 21/6-18; Sparnacien supérieur: Sinceny 21/6-7,8.

À suivre

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3. LM INVESTIGATIONS OF PARTIALLY DISSOLVED SPOROMORPHS I.

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Abstract

The light-microscopical results of partially dissolved spores and pollen grains of the recent species are summarized in this paper: *Dryopteris filix-mas, Juniperus virginiana, Betula verrucosa, Carya illinoensis, Juglans nigra* and *Platycarya strobilacea.* Seven organic solvents – diethylamine, merkaptoethanol, methanol, ethanol, n-propanol, n-butanol and i-amyl alcohol – were used. Length of time: 30, 90, 150, 210, 270 and 330 days, temperature 30°C. Taxonomically important alterations were observed at the pollen grains of *Juniperus virginiana, Carya illinoensis* and *Betula verrucosa.* In this respect the spores of *Dryopteris filix-mas*, and the pollen grains of *Juglans nigra* and *Platycarya strobilacea* are very resistant. Concerning the results of the pollen grains of *Juniperus virginiana* as a new term, the DUHOUX effect is introduced. This is the extreme swelling of the intine, which breaks the exine and peculiar forms appear. This phenomenon may be the result of different influences first observed by DUHOUX as a result of hydratation.

Key words: Palynology, recent, spores, pollen grains, partial dissolution, LM method.

Introduction

The partial degradation of the sporopollenin is based on differences in the resistance of different components of the biopolymer system, cf. ROWLEY and PRIJANTO (1977), SOUTHWORTH (1985, 1986). The partially degraded sporoderm was investigated with the TEM method, and several kinds of biopolymer units were revealed. To the levels of organization of the biopolymer structure of the sporopollenin KEDVES (1989) published a summarizing schema. Later the importance of the LM method was also recognized in the papers of KEDVES and GÁSPÁR (1994). As a surprising result the dissolution in diethylamine of the exospore of *Equisetum arvense* L. and the exine of the pollen grains of *Quercus robur* L. can be pointed out. The experiment of the pollen grains of the genus *Quercus* was repeated later (KEDVES and GÁSPÁR 1996). Other pollen grains (e. g.: *Juglans*) are resistant. Till this time within our experimental material the teliospores of *Ustilago maydis* (DE CANDOLLE) CORDA proved to be the most resistant.

Last year a new research program started to get more information about the dissolution of the spore and pollen wall of the different taxa. This program may be included to the researches of the biopolymer system of the sporopollenin.

Materials and Methods

The following species were the subjects of our investigations: *Dryopteris filix-mas* (L.) RICH.

Locality: Botanical Garden of the J. A. University. Collected: Dr. I. SZÖLLŐSI, on 14.08. 1995. Beginning of the experiments: 31.08.1995. Numbers of experiments: 1/7 – 318–360.

Juniperus virginiana L.

Locality: Botanical Garden of the J. A. University. Collected: Dr. J. PULICS, on 16.03.1995. Beginning of the experiments: 22.03.1995. Numbers of experiments: 1/7 – 1–43.

Betula verrucosa EHR.

Locality: Botanical Garden of the J. A. University. Collected: Dr. J. PULICS on 21.03.1995. Beginning of the experiments: 23.03.1995. Numbers of experiments: 1/7 – 44–88.

Carya illinoensis (WANG) K. KOCH

Locality: Botanical Garden of the J. A. University. Collected: I. GÁSPÁR on 27.05.1995. Beginning of the experiments: 08.06.1995. Numbers of experiments: 1/7 – 202–244.

Juglans nigra L.

Locality: Botanical Garden of the J. A. University. Collected: I. GÁSPÁR on 20.05.1995. Beginning of the experiments: 25.05.1995. Numbers of experiments: 1/7 – 127–169.

Platycarya strobilacea SIEB. and ZUCC.

Locality: Botanical Garden of the J. A. University. Collected: I. GÁSPÁR on 10.06.1995. Beginning of the experiments: 20.06.1995. Numbers of experiments: 1/7 – 247, 272–313.

5 mg dried spore or pollen material was measured into small glasses. 5 ml H_2O distilled and 0.2 ml diethylamine or merkaptoethanol were added to the dried experimental material. Other alcohols; methanol, ethanol, etc. 5 ml was added to 5 mg spore or pollen material. Temperature: 30°C. Length of time and the organic solvents are indicated in Plates 3.1.–3.6.

Results

Dryopteris filix-mas (L.) RICH. (Plate 3.1., figs. 1–42)

Based on light-microscopical investigations, taxonomically important alterations were not observed during these experiments. In some cases the perispore detached from the exospore.

Juniperus virginiana L. (Plate 3.2., figs. 1–42)

This series of experiment caused important alterations at this species. The basic alteration is the extreme swelling of the intine. The observed pollen grains are classified into three types: 1. The more or less intact pollen grains, the amb is circular, the ectexine is not splitted; e. g.: Plate 3.2., figs. 1–7. 2. The "hiatus form" together with the protoplasm and the thickened intine, e. g.: Plate 3.2., figs. 24,39. 3. The ectexine lost pollen grains, e. g.: Plate 3.2., figs. 17,18,20,27,41. The protoplasm is surrounded by the secondarily thickened intine, e. g.: Plate 3.2., figs. 17,18,20,27,41. The distribution of the percentages of the different forms are summarized as follows.

It is well shown that important alterations happened in consequence of diethylamine and merkaptoethanol after 210 days of dissolution. Methanol, propanol and butanol resulted also in similar alterations.

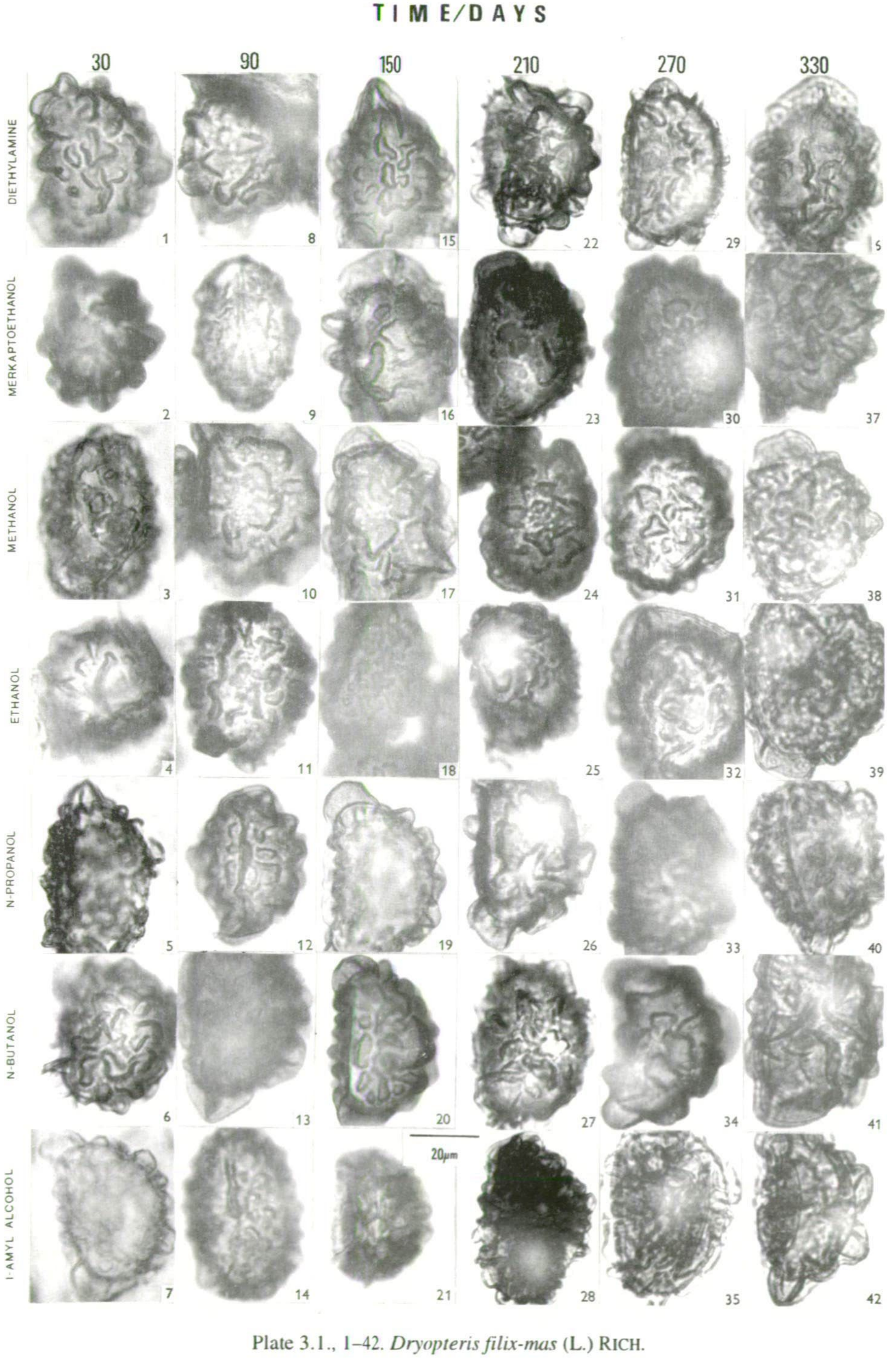

Plate 3.1., 1–42. *Dryopteris filix-mas* (L.) RICH.

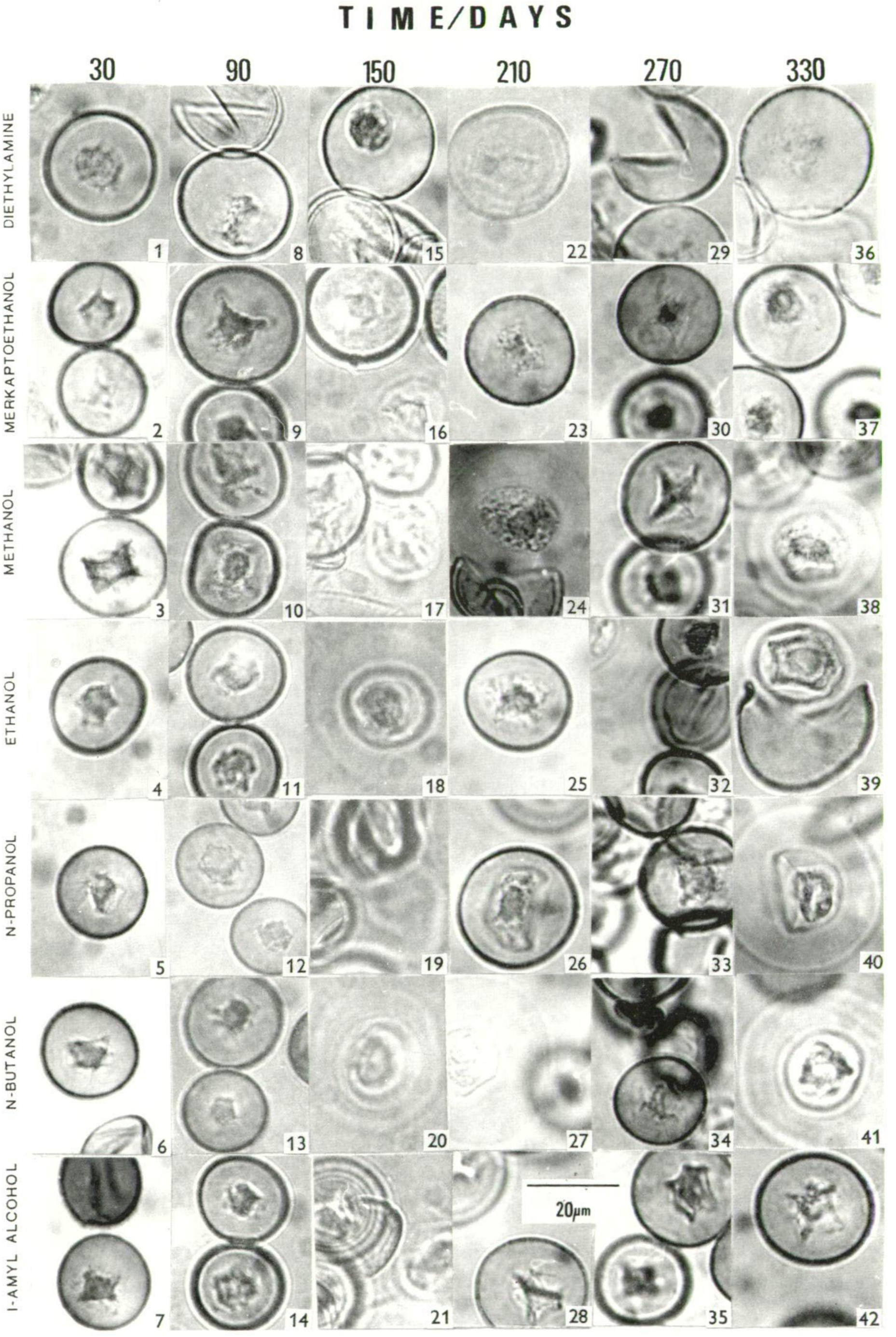

Plate 3.2., 1–42. *Juniperus virginiana* L.

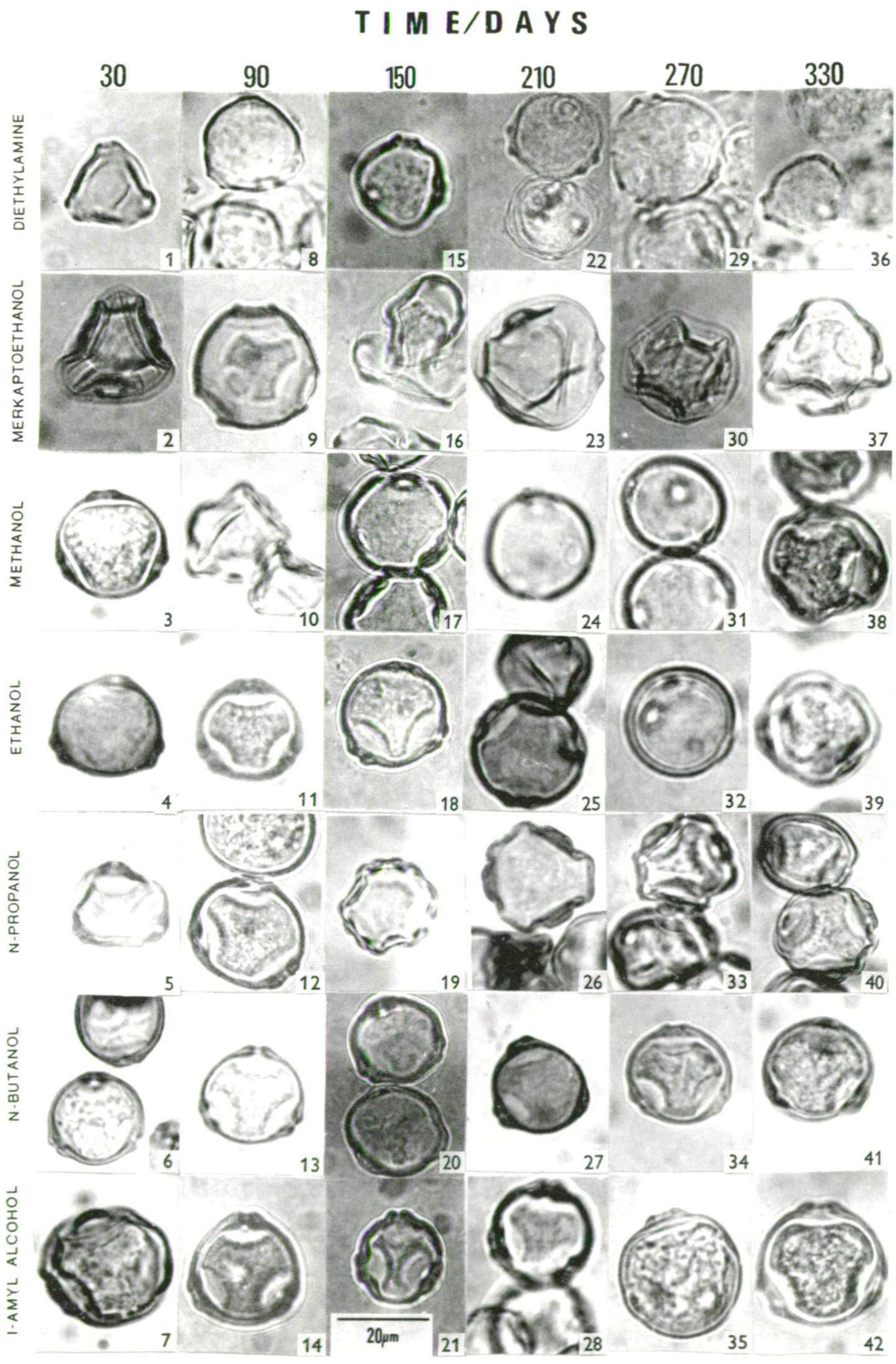

Plate 3.3., 1–42. *Betula verrucosa* EHR.

	30			90			150			210			270			330 days		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
diethylamine	72.0	26.0	2.0	70.5	28.0	1.5	71.5	27.0	1.5	68.0	8.0	24.0	63.5	10.0	26.5	86.5	0.0	13.5 %
merkaptoethanol	68.5	29.0	2.5	86.0	11.0	3.0	64.0	30.0	6.0	73.5	5.0	21.5	50.5	0.5	49.0	89.0	1.0	10.0 %
methanol	72.5	18.0	9.5	89.0	6.0	5.0	75.0	14.0	11.0	66.0	10.0	24.0	96.0	3.0	1.0	76.0	6.5	17.5 %
ethanol	72.0	25.0	3.0	69.0	26.5	4.5	48.5	33.0	18.5	64.5	12.0	23.5	43.0	3.0	54.0	97.0	2.5	0.5 %
n-propanol	75.5	16.5	8.0	71.5	18.0	10.5	51.5	28.5	20.0	84.5	9.0	6.5	54.0	1.0	45.0	55.0	5.0	40.0 %
n-butanol	75.0	23.5	1.5	70.0	17.5	12.5	41.0	20.0	39.0	43.0	5.0	52.0	62.0	0.5	37.5	52.5	5.0	42.5 %
i-amyl alcohol	65.0	21.5	13.5	62.5	32.5	5.0	66.5	21.0	12.5	98.0	0.0	2.0	87.0	1.0	12.0	87.0	11.0	2.0 %

Juniperus virginiana L.
Table 3.1.

Betula verrucosa EHR. (Plate 3.3., figs. 1–42)

Important qualitative alterations happened during this kind of experimental studies. The pollen grains were grouped into two types; 1. The relatively more or less original, trivestibulate form, e. g.: Plate 3.3., figs. 1,3–5. 2. The alterated forms which lost the original morphological characteristic features e. g.: Plate 3.3., figs. 2,19,26,30. The percentages of this two pollen types are summarized in the following.

	30		90		150		210		270		330 days	
	1	2	1	2	1	2	1	2	1	2	1	2
diethylamine	70.0	30.0	99.5	0.5	93.0	7.0	99.0	1.0	97.5	2.5	100.0	0.0%
merkaptoethanol	16.0	84.0	11.5	88.5	9.0	91.0	24.5	75.5	3.5	96.5	13.0	87.0%
methanol	99.5	0.5	100.0	0.0	89.5	10.5	95.5	4.5	100.0	0.0	80.0	20.0%
ethanol	99.0	1.0	100.0	0.0	97.5	2.5	81.0	19.0	100.0	0.0	94.5	5.5%
n-propanol	67.0	33.0	100.0	0.0	4.0	96.0	67.0	33.0	32.0	68.0	92.5	7.5%
n-butanol	96.0	4.0	100.0	0.0	99.5	0.5	75.0	25.0	99.5	0.5	97.5	2.5%
i-amyl alcohol	93.0	7.0	100.0	0.0	97.5	2.5	82.5	17.5	97.0	3.0	96.5	3.5%

Betula verrucosa EHR.
Table 3.2.

Carya illinoensis (WANG) K. KOCH (Plate 3.4., figs. 1–42)

Important qualitative alterations were observed at this kind of subtriporate *Juglandaceae* pollen type. The pollen grains were classified into two groups: 1. The more or less original but always subtriporate forms, e. g.: Plate 3.4., figs. 1–7, 18–21. 2. Peculiar pseudoplicate forms appearing after several dissolution experiments, sometimes similar to a tetrad mark. In this relation, the position of the subequatorial pores is lateral between two branches of the plicate foldings. The quantitative distribution of these two kinds of pollen forms is summarized in Table 3.3.

	30		90		150		210		270		330 days	
	1	2	1	2	1	2	1	2	1	2	1	2
diethylamine	100.0	0.0	99.5	0.5	100.0	0.0	99.5	0.5	100.0	0.0	100.0	0.0%
merkaptoethanol	61.0	39.0	50.0	50.0	43.5	56.5	25.0	75.0	32.5	67.5	31.5	68.5%
methanol	100.0	0.0	100.0	0.0	100.0	0.0	97.5	2.5	91.5	8.5	100.0	0.0%
ethanol	100.0	0.0	85.0	15.0	99.0	1.0	87.5	12.5	97.0	3.0	100.0	0.0%
n-propanol	100.0	0.0	100.0	0.0	100.0	0.0	89.0	11.0	8.0	92.0	98.0	2.0%
n-butanol	89.5	10.5	100.0	0.0	99.5	0.5	4.5	95.5	6.0	94.0	5.5	94.5%
i-amyl alcohol	100.0	0.0	100.0	0.0	95.5	4.5	99.0	1.0	98.5	1.5	98.5	1.5%

Carya illinoensis (WANG) K. KOCH
Table 3.3.

Juglans nigra L. (Plate 3.5., figs. 1–42)

No taxonomically important alterations were observed at the pollen grains of this genus.

Platycarya strobilaceae SIEB. and ZUCC. (Plate 3.6., figs. 1–42)

This kind of pollen type is also very resistant to the applied dissolution experiments.

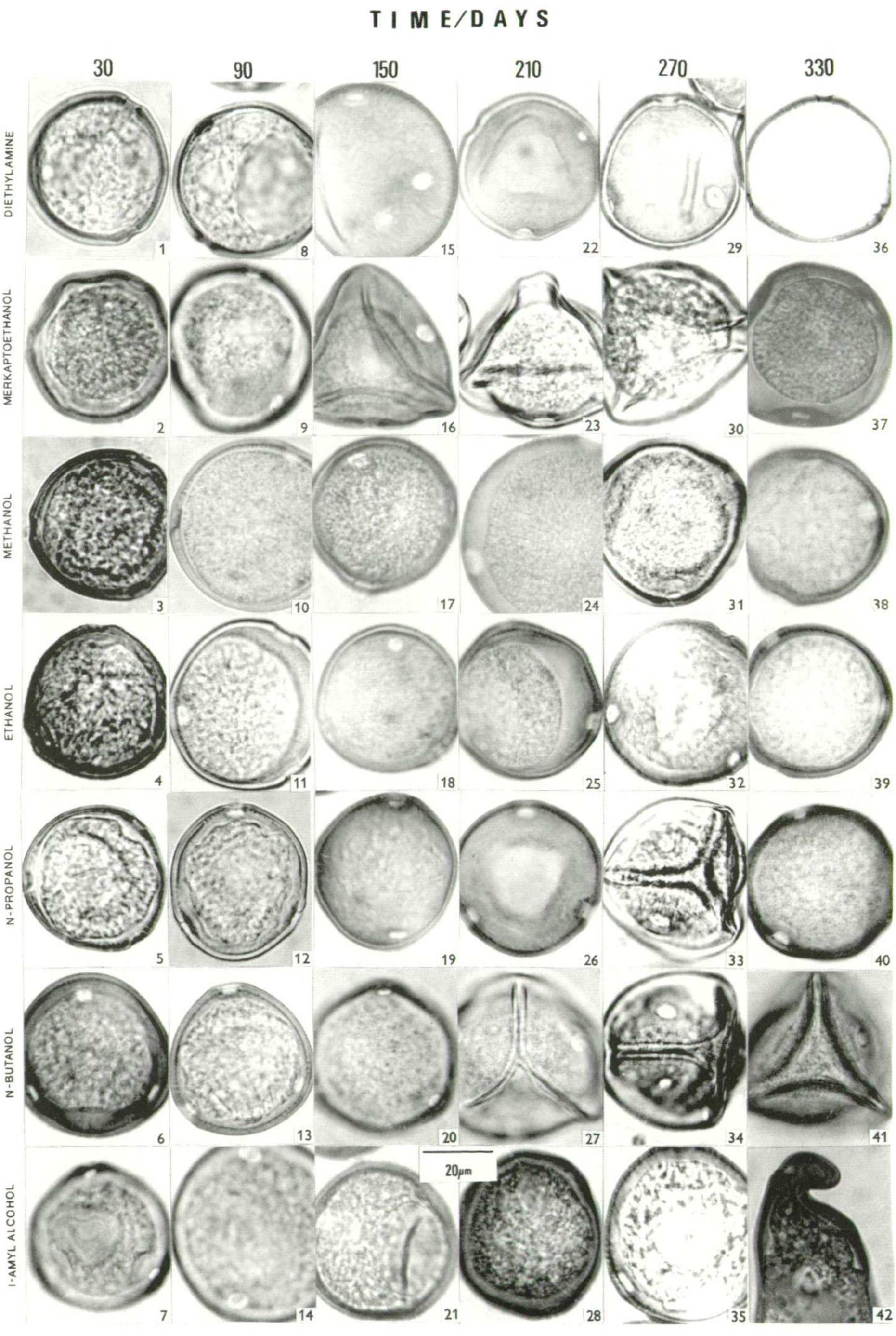

Plate 3.4., 1–42. *Carya illinoensis* (WANG) K. KOCH

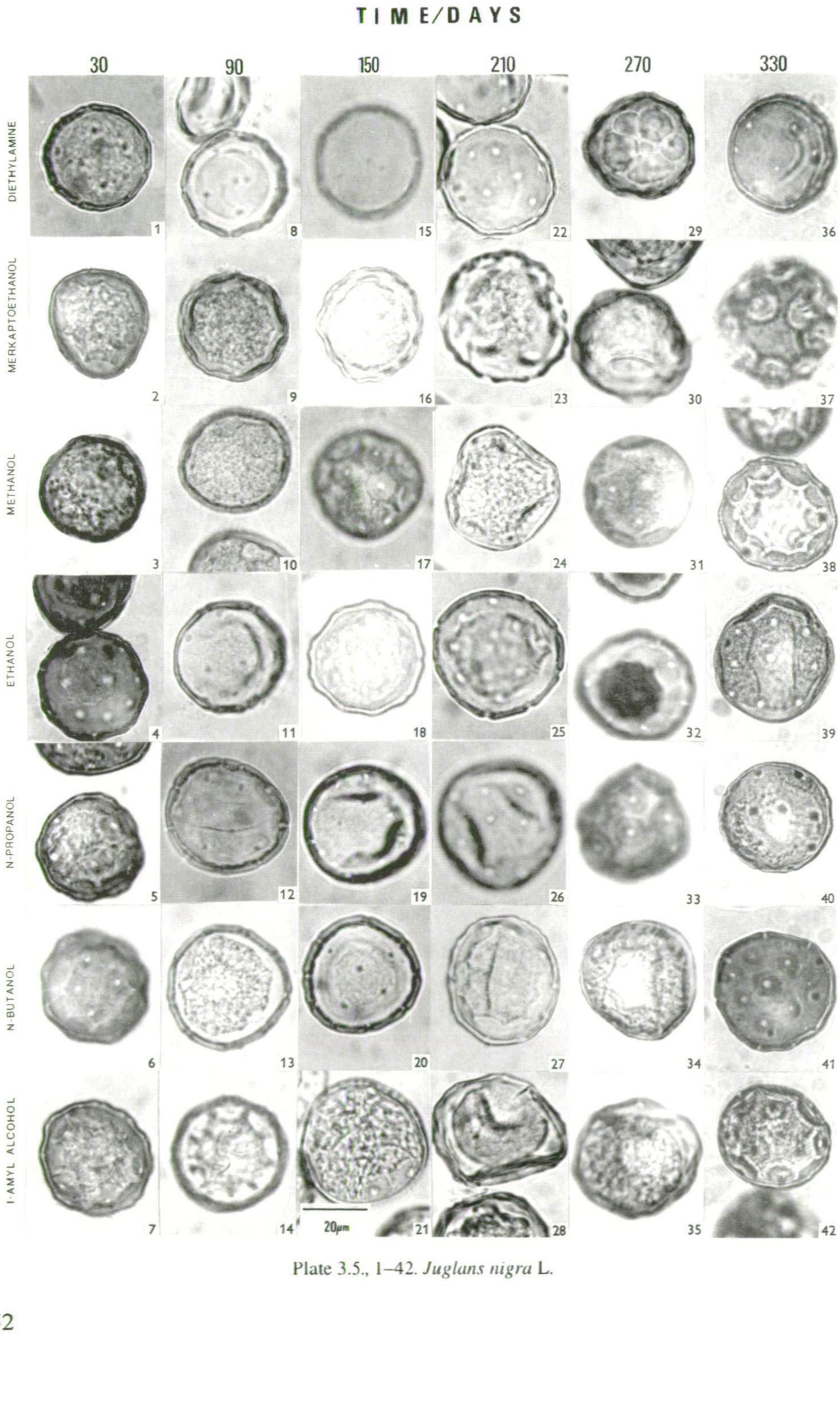

Plate 3.5., 1–42. *Juglans nigra* L.

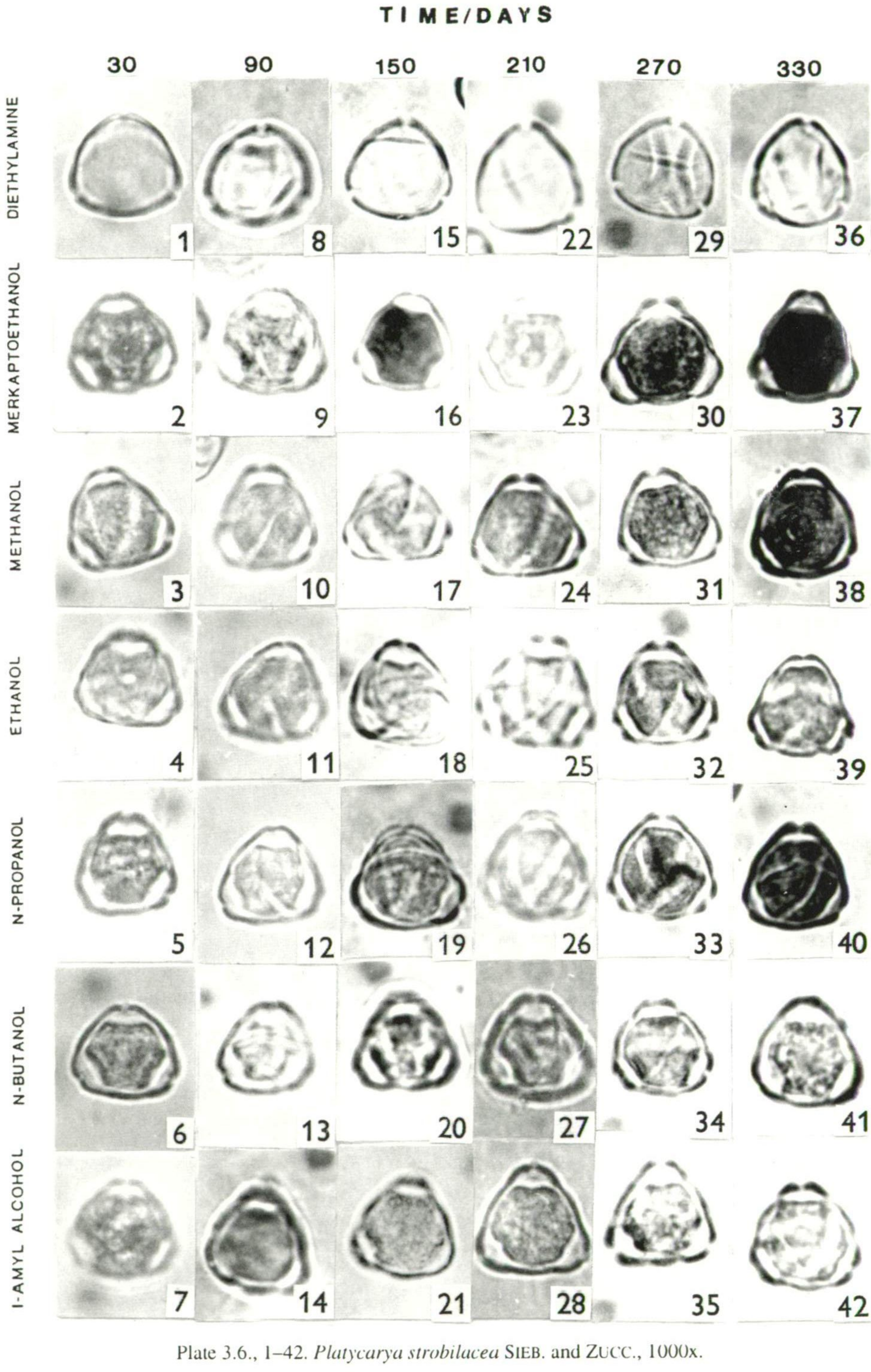

Plate 3.6., 1–42. *Platycarya strobilacea* SIEB. and ZUCC., 1000x.

Discussion and Conclusions

1. The spores of *Dryopteris filix-mas* are resistant as compared to the easily dissoluble exospore of *Equisetum arvense* (cf. KEDVES and GÁSPÁR, 1994). But based on our preliminary TEM investigations the light-microscopically intact spores may be extremely damaged. In all probability its degradation was finished during the embedding processes for the ultrathin sectioning.

2. The results concerning the pollen grains of *Juniperus virginiana* are very interesting. It was DUHOUX (1972, 1975, 1979) who described the hydrated pollen grains which lost the exine in consequence of the extremely swollen intine. This phenomenon was observed by KEDVES and UNGVÁRI (1996) after X-ray irradiation. In this way the same alteration may happen in consequence of different processes. To this we introduce the term named DUHOUX effect as follows:

The intine of the globular more or less inaperturate or monoporate gymnosperm pollen grains in consequence of exterior influences swolled extremely, disrupt and leave the exine, the protoplasm is surrounded by the extremely thickened intine.

3. The heterogeneity of the *Juglandaceae* pollen types is interesting in this respect. The resistance of the pollen grains of the genus *Juglans* against different influences was established a long time ago (cf. KEDVES and KINCSEK, 1989). *Carya illinoensis* produced interesting alterations of the dissolution experiments. When during the sedimentation other influences produce similar forms, at least two form-genuses may be established for the pollen grains of the fossil *Carya*. The resistance of the pollen grains of *Platycarya strobilacea* is also interesting. To this it seems to be very important to investigate the pollen grains of the genus *Engelhardtia*, because this is the earliest pollen type within the *Juglandaceae*.

Acknowledgements

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4. EXPERIMENTAL INVESTIGATIONS ON HUNGARIAN TERTIARY LIGNITES I.

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Abstract

An experimental, combined research program is planned on Hungarian Tertiary lignites. LM and EM methods will be used to investigate the organic matter of the secondary wood remnants. Partial dissolution method will also be used. This paper presents the methological considerations and some preliminary LM results on two samples.

Key words: Xylotomy, partial dissolution, Tertiary, Hungary.

Introduction

There are several papers concerning the anatomy with LM method of Hungarian lignites; HOLLENDONNER (1931), HARASZTY (1933, 1953, 1957, 1958), SÁRKÁNY (1943), MAÁCZ (1955), STIEBER (1955), SIMONCSICS (1956), GREGUSS (1959), KEDVES (1959). In 1967 GREGUSS published a monograph of the anatomy of the fossil *gymnosperm* woods in Hungary, including all kinds of fossilized secondary xylem.

Later, the importance of the dark coloured wood fragments was recognized in the transport of the radioactive elements in the Hungarian Holocene sediments (KEDVES and KÖRMÖCZI, 1985, KEDVES and SZEDERKÉNYI, 1985, 1988). KEDVES and SZEDERKÉNYI (1988) described the ultrastructure of the xylem remnants transporting radioactive elements reworked into the mud of Lake Vadkert in Hungary. In this paper the following facts were established:

1. The ultrastructure of the xylem remnants is not identical in the different samples investigated. This is the consequence of the different degree of coalification, or the taphonomical processes.
2. The lamellar ultrastructure was in some places discernible.
3. Granules with high electron density are in the organic debris enclosing the xylem fragments.

Taking into consideration the importance of the ultrastructure data of the xylem remnants in the reconstruction of the sedimentation processes, a new research program was projected to the LM and EM investigations on Hungarian, mostly Tertiary lignites. The aim of this paper is to present the basic methods of the projected investigations together with the first results of the LM morphology of two lignite samples.

Materials and Methods

About 25–30 samples of lignite from different localities and ages (Miocene to Pliocene) are planned for combined investigations. The samples were collected and investigated previously with two kinds of research concepts and methods:

1. Paleoecological, Geological and Paleontological (*Mollusca, Ostracoda, Nannoplankton*, etc.), supported by Grant OTKA 1/5, T 007482, responsible for the program Dr. M. SZÓNOKY (Department of Geology and Paleontology of the J. A. University, Szeged, Hungary).
2. Organic Geochemistry concept supported by Grant OTKA 1/5, T 007429 responsible Dr. M. HETÉNYI (Department of Mineralogy, Petrography and Geochemistry of the J. A. University, Szeged, Hungary).

The methods used for the wood anatomy are the following:

1. LM studies
1.1. The so-called classical thin sections were made for the determination of the botanical affinities of the lignite remnants and to establish the preservation and the Paleoecology of the samples investigated.
1.2. These data were completed with those of the macerations material with SCHULTZE or DUBERT mixture. The remains of the macerations were coloured with Toluidine Blue.
2. Experimental LM and TEM investigations
2.1. The first step was to eliminate the inorganic components of the xylem fragments, with HCL aq. dil. and HF aq. dil.
2.2. After carefully washing the organic material in distilled water, the samples were broken into small fragments. This material was shaken in distilled water in a measuring testtube of 100 ml. After 5 second of deposition the small lignite pieces containing liquid part overflew. This matter was shaken again and 5-5 ml of woody fragments containing water were measured for experimental studies.
2.3. Three kinds of material were investigated.
2.3.1. The so-called zero material without experiment.
2.3.2. 0.2 ml diethylamine was added to the 5 ml xylem fragments containing water.
2.3.3. 0.2 ml merkaptoethanol was added to the 5 ml xylem fragments containing water.
2.4. The material, prepared by the previous methods is ready for partial dissolution. This was made in a thermostat at 30 °C during 30 days.
2.5. After this partial dissolution the woody fragments were carefully washed with distilled water.
2.6. For LM investigations the fragments were again coloured with Toluidine Blue, the slides were mounted in glycerine-jelly, hydrated at 39.6%.
2.7. For TEM studies fixation was done in Millonig buffered 1% osmium tetroxide for 1 hr. After fixation the material was washed in a 0.2 M Millonig (osmium-tetroxide-free) phosphate buffer overnight. Dehydratation was performed in an ascending series of ethanol in 15 min. steps, including uranyl acetate staining in 70% ethanol. The samples were embedded in Durcupan (Fluka) araldite epoxy resin in gelatin capsules and polymerized at 56 °C thermostat for 3 days. The ultrathin sections will be made in the Electron Microscopical Laboratory of the Institute of Biophysics of the Biological Center of the Hungarian Academy of

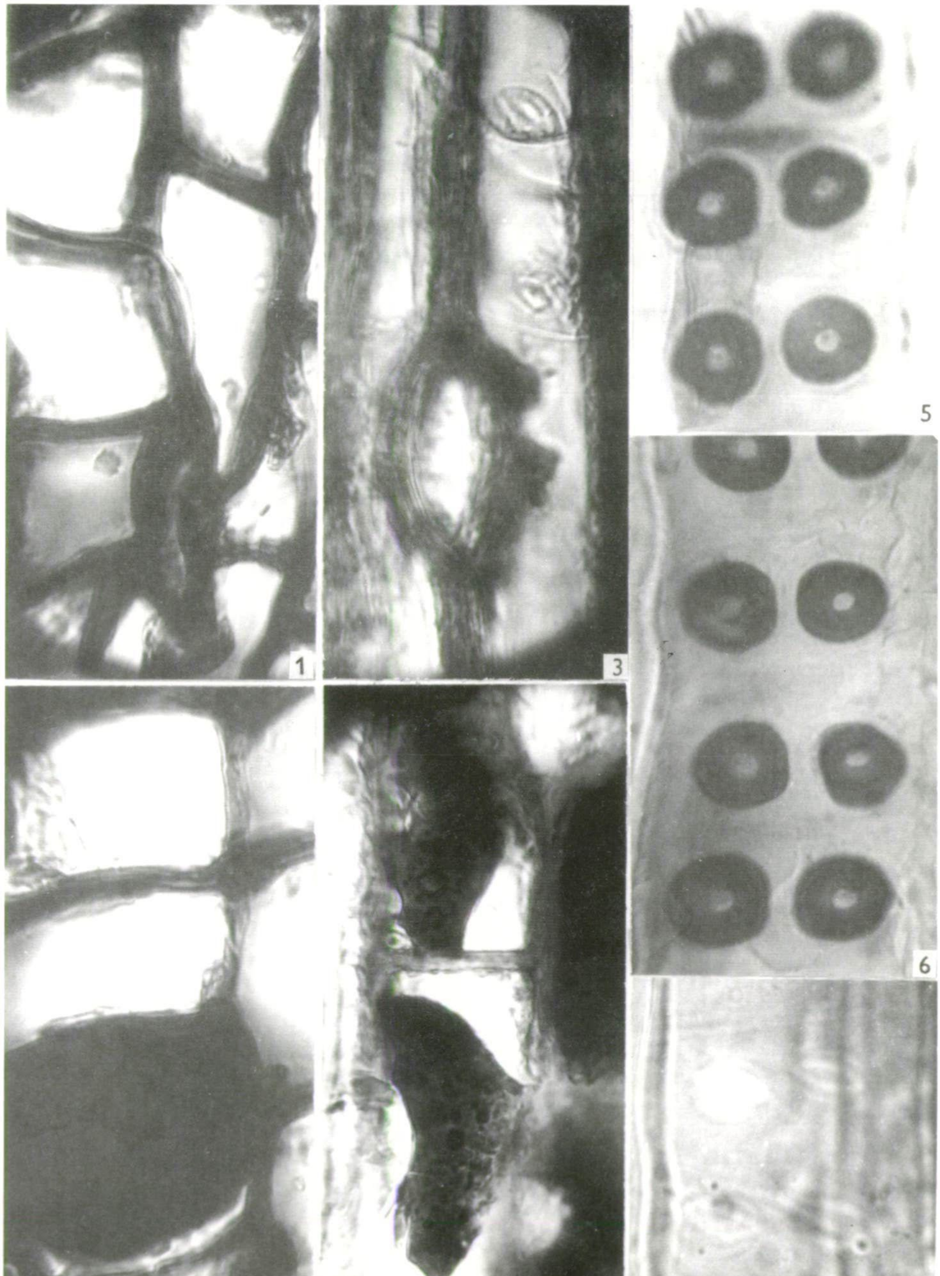

Plate 4.1.

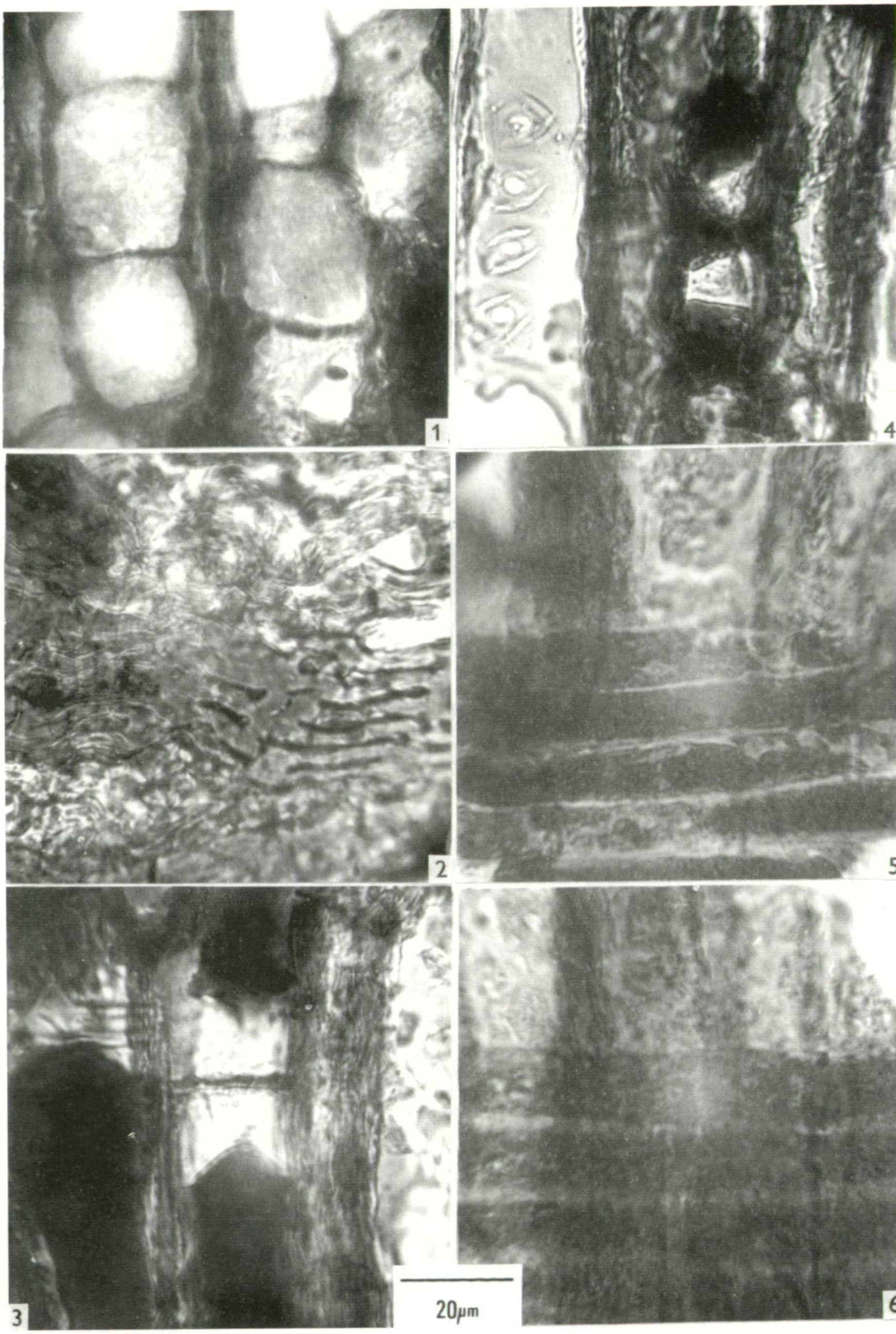

Plate 4.2.

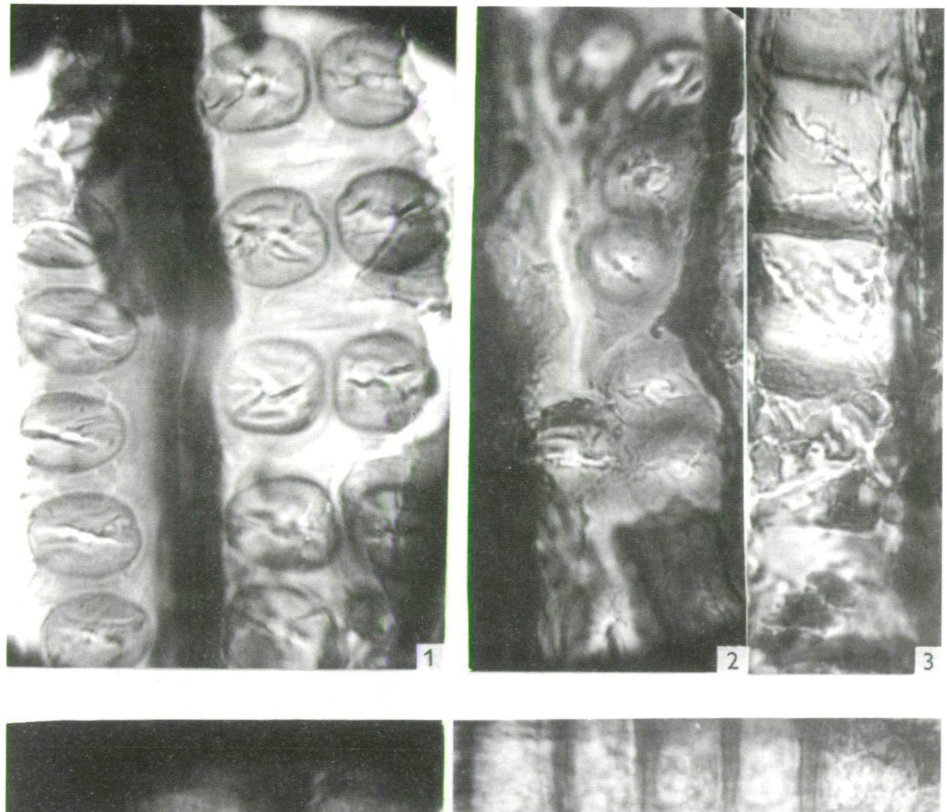

Plate 4.3.

Sciences on Porter Blum ultramicrotome. The TEM pictures will also be taken in this Laboratory.

In this paper the results of the LM investigations of the following two samples are presented:

Sample, No 1.

Locality: Salgótarján, Miocene. The woody samples are deposited in the collection of the Department of Geology and Paleontology of the J. A. University, Szeged, number: UC_2 1047. The samples were handed over for my investigations by Dr. M. SZÓNOKY.

Sample, No 2.

Locality: Sopron, Lower Pannonian, brick factory, collected by Dr. M. SZÓNOKY on 15.04.1988, the samples are deposited in the Department of Geology and Paleontology of the J. A. University, Szeged.

Results

Sample, No 1 (Plate 4.1., figs. 1–7, plate 4.3., figs. 1–3)
Sequoioxylon gypsaceum (GÖPPERT) GREGUSS 1967

Wood anatomical characteristic features important from taxonomic points of view are well preserved. The non-experimental material was investigated on thin sections (Plate 4.1., figs. 1–4) and macerated with the DUBERT's mixture (Plate 4.1., figs. 3–7). The longitudinal parenchyma cells contain resin drops (Plate 4.1., figs. 2,4). The horizontal wall of the longitudinal parenchyma cell is smooth without thickenings (Plate 4.1., fig. 4). In some places there are bordered pits on the tangential side of the tracheids (Plate 4.1., fig. 3). There are bi-seriate bordered pits on the radial wall of the tracheids. Bars of Sanio or crassulae are present (Plate 4.1., figs. 5,6). Cross-field pits are mostly two or more of taxodioid type (Plate 4.1., fig. 7). After dissolution with diethylamine (Plate 4.3.,

Plate 4.1.

1–7. *Sequoioxylon gypsaceum* (GÖPPERT) GREGUSS 1967
1,2. Cross sections of the tracheids.
3,4. Tangential sections.
5,6. Bordered pits and bars of Sanio.
7. Cross-field pits.

Plate 4.2.

1–6. *Sequoioxylon medullare* GREGUSS 1967
1,2. Cross sections of the tracheids.
3,4. Tangential sections.
5,6. Radial sections.

Plate 4.3.

1–3. *Sequoioxylon gypsaceum* (GÖPPERT) GREGUSS 1967, partially dissolved tracheids.
1. Dissolution with diethylamine.
2,3. Dissolution with merkaptoethanol.
4–6. *Sequoioxylon medullare* GREGUSS 1967, partially dissolved xylem.
4,5. Dissolution with diethylamine.
6. Dissolution with merkaptoethanol.

fig. 1) and merkaptoethanol (Plate 4.3., figs. 2,3) important alterations may be observed by the LM method, too. Particularly at the pits of the radial wall of the tracheids, and the cross-field pits lost their original LM morphology.

Sample, No 2 (Plate 4.2., figs. 1–6, plate 4.3., figs. 4–6)
Sequoioxylon medullare GREGUSS 1967

The preservation of the tissue of the secondary wood is not identical on a small piece of the lignite sample (Plate 4.2., figs. 1,2). A relatively well preserved part is illustrated in fig. 1, in cross-section. In the 2nd picture in contrast to this the original structure is hardly damaged and compressed at this part of the lignite. The most important LM morphological characteristic features of the lignite sample are the following: The longitudinal parenchyma cells contain resins, its longitudinal wall is smooth (Plate 4.2., fig. 3). There are bordered pits on the tangential wall of the tracheids (Plate 4.2., fig. 4). The bordered pits of the radial wall of the tracheids are damaged, uni- or bi-seriate (Plate 4.2., figs. 5,6). The ray cells are in general filled with dark content, therefore they cannot be so easy established (Plate 4.2., figs. 5,6). There are 3–5 small cross-field pits (Plate 4.2., figs. 5,6). The diethylamine (Plate 4.3., figs. 4,5) and the merkaptoethanol (Plate 4.3., fig. 6) altered the morphological characteristic features of the lignite tissue. The cell contents were dissolved and the size and the character of the cross-field pits have been altered (Plate 4.2., figs. 4–6).

Discussion and Conclusions

As it was emphasized previously, this paper is a preliminary report of a new research program, with the attempt to elaborate the basic methods for the series of investigations. But based on our previous experiences of the partially dissolved spores and pollen grains, the ultrastructure may change without alterations in the LM morphology. It is worth of mentioning, that there are important alterations in the LM morphology of the two lignite samples investigated in consequence of both organic solvents. In this way it is presumable to get some information to the fine structure of the wall and sometimes the resin and other contents of the Hungarian lignites.

Acknowledgements

This work was supported by Grant OTKA 1/7 T 014692.

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5. LM INVESTIGATIONS OF PARTIALLY DISSOLVED SCLEREIDS OF ARMENIACA VULGARIS LAM.

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Abstract

Sclereids of the endocarp of *Armeniaca vulgaris* were partially dissolved with diethylamine and merkaptoethanol, at 30 °C, during 5, 10, 20, 25, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330 and 360 days. For LM studies the partially dissolved sclereids were coloured with Toluidine Blue. This experiment has not altered in a perceptible measure the basic morphology of the thick wall of the sclereids. The alteration, namely the relative accumulation of the aromatic lignin derivates can be followed by the alteration of the colour of the Toluidine Blue stain. This alteration started after 10 days of dissolution, the colour changed to bluish-green, in contrast to the intensive blue colour of the sclereids dissolved for 5 days. In general the dissolution of the non-aromatic derivates was more intensive with diethylamine than with merkaptoethanol.

Key words: Armeniaca vulgaris, sclereids, partial dissolution, LM method.

Introduction

The TEM study of our Laboratory of partially degraded sporomorphs under natural and in vitro conditions started in 1974, with the paper of KEDVES, STANLEY and ROJIK. Later several papers were published dealing with the biopolymer structure and symmetry of the recent and fossil sporoderm. Collateral to the sporoderm partially degraded parenchyma, xylem and sclereids were also investigated with the TEM method. Preliminary results were published, cf. KEDVES (1991).

In 1991, KEDVES and ROJIK described regular pentagonal biopolymer units from partially degraded and fragmented sclereids of *Armeniaca vulgaris*. Results of the TEM investigations of the ultrathin sections of the partially degraded sclereids were published by KEDVES and PÁRDUTZ (1992). In recent years we started an extensive research program on the partially degraded sclereids of *Armeniaca vulgaris*. This contribution presents the first part of a long-lasting dissolution experiment, namely the results obtained by the LM method. This paper will be followed by the TEM results of the partially degraded and fragmented sclereids, including the symmetry operations of the biopolymer structures.

Materials and Methods

The material for investigation was collected by A. VÉR on 30.07.1991 in her garden. The cleaned endocarps were frozen at –20 °C, to avoid or diminish the alterations of the oxydation. On 28.01.1993 the material was dried for three days at 30 °C. After the endocarps were broken and filtered on an 0.4 mm sieve. The fragments of this size were used for experimental studies. To 20 mg fragments of endocarp sclereids 0.2 ml organic solvents (diethylamine and/or merkaptoethanol) were added. Temperature 30 °C. The experiments started on 02.02.1993.

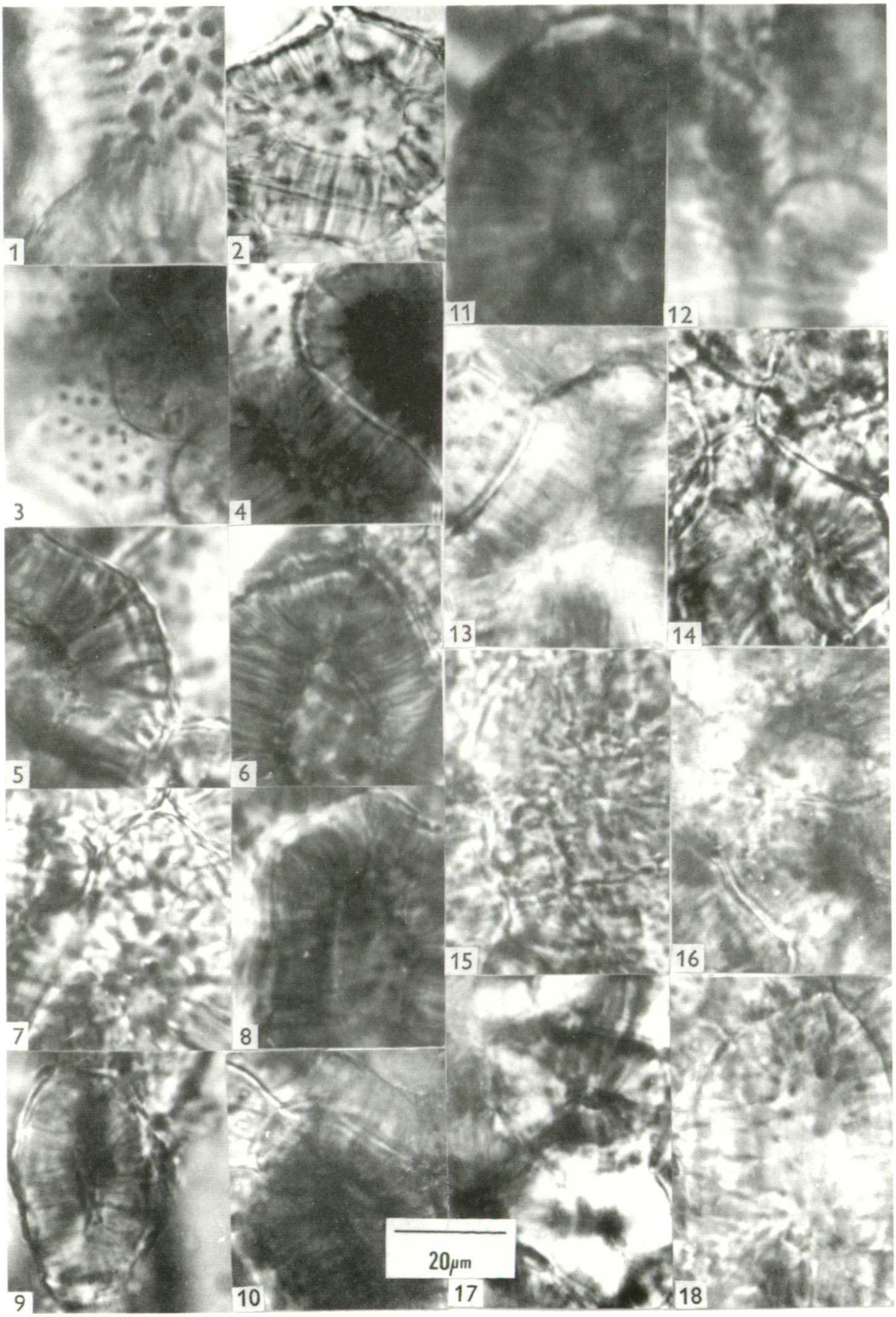

Plate 5.1.

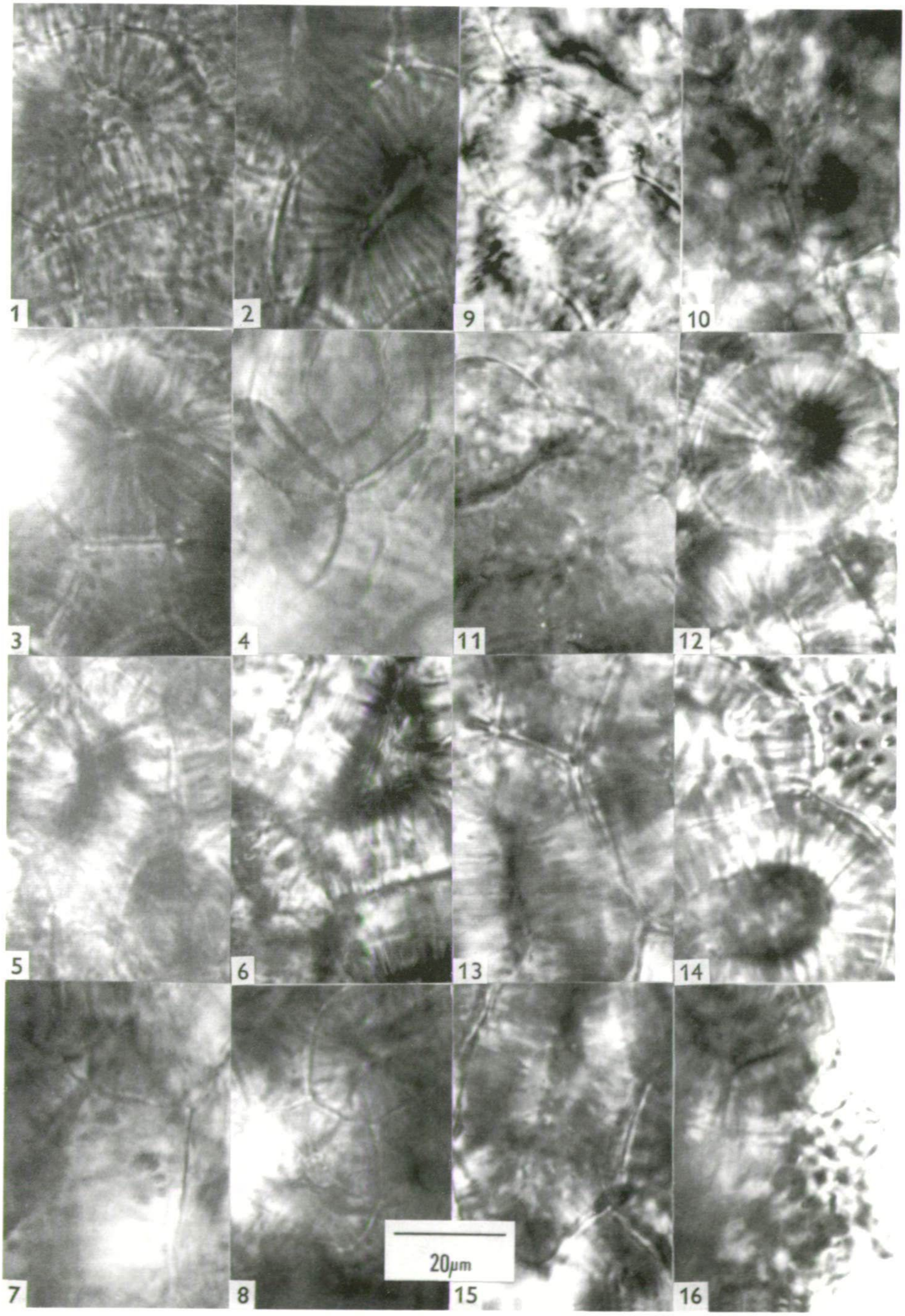

Plate 5.2.

No of experiment	Solvents diethylamine	merkaptoethanol	Length of time in days
1602	+		5
1603		+	5
1604	+		10
1605		+	10
1606	+		15
1607		+	15
1608	+		20
1609		+	20
1610	+		25
1611		+	25
1612	+		30
1613		+	30
1614	+		60
1615		+	60
1616	+		90
1617		+	90
1618	+		120
1619		+	120
1620	+		150
1621		+	150
1622	+		180
1623		+	180
1624	+		210
1625		+	210
1626	+		240
1627		+	240
1628	+		270
1629		+	270
1630	+		300
1631		+	300
1632	+		330
1633		+	330
1634	+		360
1635		+	360

After dissolution the sclereids were washed carefully in distilled water. For LM studies the fragments were coloured with Toluidine Blue.

Plate 5.1.

1–18. *Armeniaca vulgaris* LAM., sclereids.
1. Experiment No: 1602, 2. Experiment No: 1603, 3. Experiment No: 1604, 4. Experiment No: 1605, 5. Experiment No: 1606, 6. Experiment No: 1607, 7. Experiment No: 1608, 8. Experiment No: 1609, 9. Experiment No: 1610, 10. Experiment No: 1611, 11. Experiment No: 1612, 12. Experiment No: 1613, 13. Experiment No: 1614, 14. Experiment No: 1615, 15. Experiment No: 1616, 16. Experiment No: 1617, 17. Experiment No: 1618, 18. Experiment No: 1619.

Plate 5.2.

1–16. *Armeniaca vulgaris* LAM., sclereids.
1. Experiment No: 1620, 2. Experiment No: 1621, 3. Experiment No: 1622, 4. Experiment No: 1623, 5. Experiment No: 1624, 6. Experiment No: 1625, 7. Experiment No: 1626, 8. Experiment No: 1627, 9. Experiment No: 1628, 10. Experiment No: 1629, 11. Experiment No: 1630, 12. Experiment No: 1631, 13. Experiment No: 1632, 14. Experiment No: 1633, 15. Experiment No: 1634, 16. Experiment No: 1635.

Results

(Plate 5.1., figs. 1–18, plate 5.2., figs. 1–16)

The light-microscopical morphology of the sclereids did not change in a considerable measure. The microphotographs in Plates 5.1., and 5.2. well illustrate the differences in the symmetry and general morphology of the sclereids. The effects of the two solvents followed by Toluidine Blue are the following:

The colour of the sclereids at experiment 1602 and 1603 is blue. From 1604 and 1605 until 1608 and 1609 the colour altered to bluish-green. After the above mentioned experiments the colour alteration caused by the two solvents is different. Green colour appeared (indicating the relative accumulation of the lignin derivates) at the sclereids of all further dissolution with diethylamine (1610, 1612, 1614, 1616, 1618, 1620, 1622, 1624, 1626, 1628, 1630, 1632). Finally the colour after the longest dissolution is yellowish green.

The colour of the sclereids dissolved partially with merkaptoethanol is bluish-green (1609, 1611, 1613, 1615, 1617, 1619, 1621, 1623, 1625, 1627, 1629, 1631, 1633, 1635).

Discussion and Conclusions

The alteration in consequence of the partial dissolution of the sclereids of *Armeniaca vulgaris* can be followed by the change of colour of Toluidine Blue. The dissolution of the non-aromatic compounds are more intensive with diethylamine. Merkaptoethanol did not dissolve completely the non-lignin derivate compounds even after 360 days.

Acknowledgements

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6. HIGH TEMPERATURE EFFECT ON THE POLLEN GRAINS OF LARIX DECIDUA MILL.

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Abstract

The LM morphology of fresh, and the qualitative and quantitative alteration of heated pollen grains of *Larix decidua* are presented in this paper. The non-inaperturate morphology is expressed at the secondarily altered specimens. Some of them are similar to the *Taxodiaceae* pollen grains.

Key words: Palynology, recent, *Larix decidua*, high temperature effect.

Introduction

POTONIÉ (1931) published the *Sporonites (?) magnus* for the large inaperturate fossil forms. Later POTONIÉ and GELLETICH (1933) used the name *Laevigatasporites* (?) cf. *magnus*. In 1934 POTONIÉ described the *Pollenites magnus* (syn.: 1931 *Sporonites* (?) *magnus* R. POTONIÉ, Zeitschr. Braunkohle, S. 556, Abb. 6.). As recent comparative material *Larix decidua* (ca 50–100 μ) and *Larix europea* (ca. 100 μ) were used. This nomenclature was followed in the paper by POTONIÉ and VENITZ (1934). RAATZ (1937) introduced the *Larixpollenites* genus. THIERGART (1940) published these large inaperturate forms as *Larix-Poll. magnus* R. POT., THOMSON and PFLUG (1953) as *Inaperturopollenites magnus* (R. POT.) n. comb. POTONIÉ (1958) summarized the following, p. 77:

Laricoidites (al. *Pollenites*) *magnus* R. POT. 1934
Laricoidites (al. *Pollenites*) *magnus* (R. POT.) in WOLFF 1934
Laricoidites magnus (R. POT.) POT., THOMS. and THIERG. 1950
Laricoidites (al. *Laricoipollenites*) *magnus* (R. POT.) in R. POT. 1951
Laricoidites magnus (R. POT.) in LESCHIK 1952
Laricoidites (al. *Inaperturopollenites*) *magnus* (R. POT.) in THOMS. & PFLUG 1953.

KRUTZSCH (1962) pointed out that *Pollenites magnus* R. POT. 1934 is the remnant of a planctonic organism. Later, KRUTZSCH (1971) established for these forms, as a valid form-genus the *Psophosphaera* (NAUMOVA 1937, 1938, ? 1950) ex BOLCHOVITINA 1953 "– Tertiär: *Larix/Pseudotsuga*-Typen –" *Psophosphaera pseudotsugoides* n. sp. nomen was introduced. E. NAGY (1985) described the *Laricispollenites gerceensis* n. g. n. sp.

Regarding the LM morphology of the recent taxa of the *Larix* genus, M. VAN CAMPO (1947) described in detail the pollen morphology of *Larix europaea*. She established a circular differentiation of the exine (bourrelet circulaire) as a remnant of the cappus (callote). ERDTMAN (1954) published the pollen grains of *Larix* as inaperturate. In 1965, ERDTMAN described the distal leptoma and the proximal annular sexinous thickening (UENO, 1960), and laesura-like lists (YAMAZAKI and TAKEOKA, 1962).

GULLVAG (1966) published the exine ultrastructure of *Larix decidua*.

The above mentioned problems support the idea of a combined investigation of the pollen grains of the *Larix* genus. This is the first part within this project.

Materials and Methods

The material for investigations was collected by Á. KÁROSSY on 11.04.1996. Locality: Garden of the J. A. University. The experiments were started on 12.04.1996. Temperature 200 °C, length of time and numbers of experiments are as follows. 0': 1/7-361, 10': 1/7-362, $1^{hr.}$: 1/7-363, $5^{hrs.}$: 1/7-364, $10^{hrs.}$: 1/7-365, $25^{hrs.}$: 1/7-366, $50^{hrs.}$: 1/7-367. The slides for light-microscopical investigations were mounted in glycerine-jelly hydrated at 39.6%. 200 specimens of each sample were investigated qualitatively and quantitatively, except 1/7-365 because there were only 140 measurable pollen grains. The pictures were taken with an objective Carl Zeiss Jena, GF Planachromat HI 100x/1.25/0.17-A.

Results

QUALITATIVE DATA

The most important morphological characteristic features of the fresh and heated pollen grains during 10' are identical. These pollen grains are in turgescent state (Plate 6.1., fig. 1,2). In picture 2, of Plate 6.1., the "distal leptoma" and the "proximal annular sexinous thickening" sensu ERDTMAN (1965), after UENO (1960), cf. "bourrelet circulaire" (M. VAN CAMPO, 1947), is a remnant of the "callote" = cappa, cappus. Important qualitative alterations started after 1 hour of heating. The most important LM morphological alterations are summarized as follows:

1. After heating for $1^{hr.}$, $5^{hrs.}$ and $10^{hrs.}$ in all probability secondary morphological characteristic features appeared on the distal leptoma. Differentiations, similar to tetrad scar (Plate 6.1., figs. 3,7) and sulcus or furrow-like formations (Plate 6.1., fig. 6).
2. The so-called taxodiaceous morphology appeared after $25^{hrs.}$ of heating. This form may be identical to the "distal depressions" of M. VAN CAMPO (1947) observed on dried pollen grains.
3. The spherical form appeared again after $50^{hrs.}$ of heating (Plate 6.1., fig. 9). These forms are similar to the extremely altered forms of *Equisetum arvense* spores of the high temperature effect or Paleozoic algal cysts. These forms are contracted, the surface is hummocky (Plate 6.1., fig. 9).

Plate 6.1.

1–9. *Larix decidua* MILL. Recent.
1. Pollen grain without heating; 1/7-361.
2. Experiment No: 1/7-362, length of time: 10 min.
3,4. Experiment No: 1/7-363, length of time: 1 hr.
5. Experiment No: 1/7-364, length of time: 5 hrs.
6,7. Experiment No: 1/7-365, length of time: 10 hrs.
8. Experiment No: 1/7-366, length of time: 25 hrs.
9. Experiment No: 1/7-367, length of time: 50 hrs.

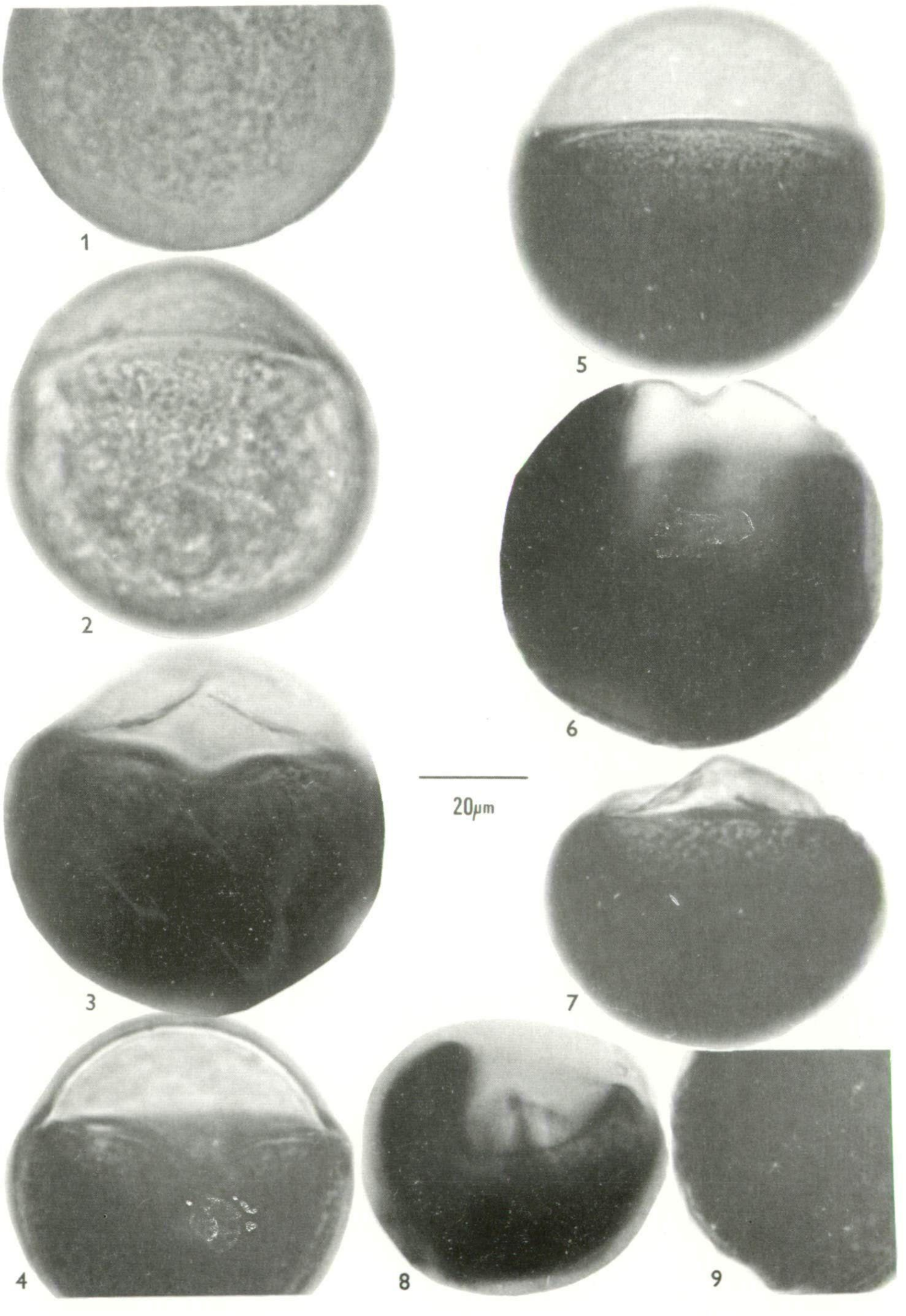


Plate 6.1.

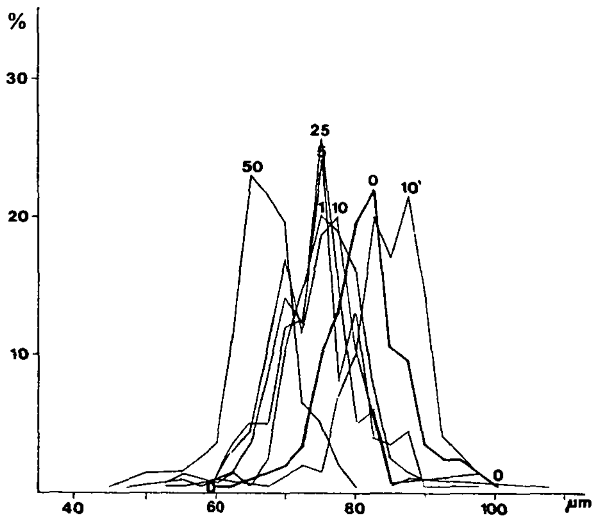
QUANTITATIVE DATA

(Text-figs. 6.1., 6.2.)

1. The pollen grains without heating are usually spherical. Diamater: 60–100 µm, L/S ratio: 1.0–1.6 (L = the longest, S = the smaller size of the pollen grain). Dominant diameter: 75.0–87.5 µm, dominant ratio: 1.0–1.2.

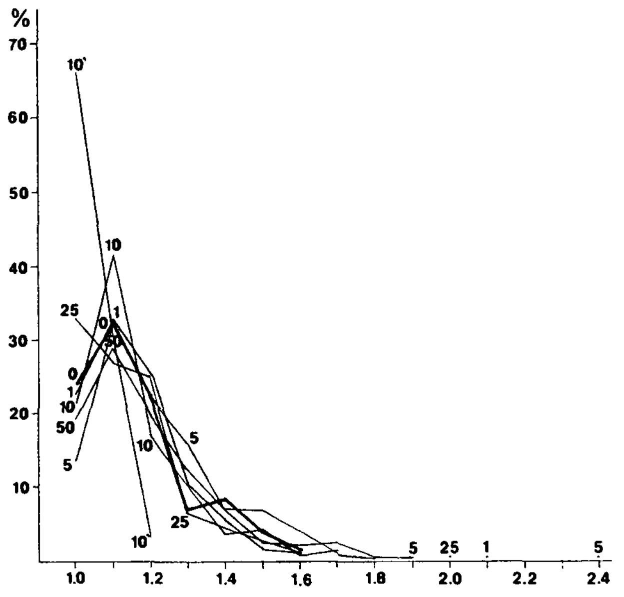
2. After 10' of heating the diameter of the pollen grains increased. The most typical pollen form is isodiametric. Diameter: 60.0–97.5 µm, L/S ratio: 1.0–1.2. Dominant diameter: 80.0–90.0 µm, dominant ratio: 1.0–1.1. The ratio value 1 is more than 66.0%.

3. After $1^{hr.}$ the pollen diameter started to decrease. Diameter: 47.5–90.0 µm, L/S ratio: 1.0–2.1. Dominant diameter: 70.0–80.0 µm, dominant ratio: 1.0–1.3.



Text-fig. 6.1.

Larix decidua MILL. Recent. Variation-statistical graphs of the longest size of the pollen grains.



Text-fig. 6.2.

Larix decidua MILL. Recent. Variation-statistical graphs of the L/S ratio of the pollen grains.

4. After $5^{hrs.}$ of heating the diameter of the pollen grains continued to decrease, and several secondary forms were observable. Diameter: 60.0–107.5 μm, L/S ratio: 1.0–2.4. Dominant diameter: 67.5–107.5 μm, dominant ratio: 1.0–1.3.

5. After $10^{hrs.}$ of heating there were only 140 measurable pollen grains in the slides. Diameter: 52.5–97.5 μm, L/S ratio: 1.0–1.7. Dominant diameter: 70.0–80.0 μm, dominant ratio: 1.0–1.3.

6. After $25^{hrs.}$ of heating the diameter of the pollen grains increased. Results in diameter are similar to those of 10^{hrs}. but there are deviations in the L/S ratio. Diameter: 52.5–97.5 μm. L/S ratio: 1.0–2.0. Dominant diameter: 70.0–80.0 μm, dominant ratio: 1.0–1.2.

7. After 50^{hrs}. of heating the pollen grains shrinked. The amb of the pollen grains was zigzag and the colour was dark. Diameter: 45.0–80.0 μm, L/S ratio: 1.0–1.8. Dominant diameter: 62.5–70.0 μm, dominant ratio: 1.0–1.3.

The important alterations during the experiments are:

Shrinkage at heating during $1^{hr.}$, $5^{hrs.}$ and $50^{hrs.}$.

Swelling at heating during 10', $10^{hrs.}$ and $25^{hrs.}$.

The quantitative data are summarized in the following tables.

Polar axis

Length of time of heating	Smallest size in µm	Size dominant in quantity (µm)	Longest size in µm	Distance between smallest and largest specimens (µm)
0	60.0	81.45	100.0	40.0
10'	60.0	84.46	97.5	37.5
$1^{hr.}$	47.5	75.71	90.0	42.5
$5^{hrs.}$	60.0	73.47	107.5	47.5
$10^{hrs.}$	52.5	73.87	97.5	45.0
$25^{hrs.}$	52.5	74.66	97.5	45.0
$50^{hrs.}$	45.0	66.52	80.0	35.0

L/S ratio

Length of time of heating	Smallest	Dominant in quantity	Largest	Distance between smallest and largest ratio
0	1.0	1.16	1.6	0.6
10'	1.0	1.04	1.2	0.2
$1^{hr.}$	1.0	1.16	2.1	1.1
$5^{hrs.}$	1.0	1.21	2.4	1.2
$10^{hrs.}$	1.0	1.16	1.7	0.7
$25^{hrs.}$	1.0	1.14	2.0	1.0
$50^{hrs.}$	1.0	1.2	1.8	0.8

Discussion and Conclusions

The experimental results presented herein support the morphological establishments of M. VAN CAMPO (1947) on the pollen grains of *Larix europaea*.

New experiments are needed, including new TEM investigations of the experimentally altered pollen grains.

Acknowledgements

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7. HIGH TEMPERATURE EFFECT ON THE POLLEN GRAINS OF PSEUDOTSUGA MENZIESII (MIRB.) FRANCO

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Abstract

Results of LM morphology of the fresh and secondary altered pollen grains by means of the high temperature effect are presented in this paper. Within the secondary altered forms there are also monosulcate pollen grains.

Key words: Palynology, recent, *Pseudotsuga menziesii*, high temperature effect.

Introduction

The review of the "large inaperturate" fossil pollen grains was compiled by BORBOLA (1997). As it was presented for the botanical affinity in the first publications the *Larix* genus was established. Later, THOMSON and PFLUG (1953), KRUTZSCH (1971) mentioned the *Pseudotsuga* genus in this respect, as well.

Similarity in the LM morphology of the pollen grains of the recent *Larix* and *Pseudotsuga* species was pointed out in several publications, cf. ERDTMAN (1954, first edition 1934). But M. VAN CAMPO (1947a) concerning *Pseudotsuga douglasii* pollen grains pointed out the following; p. 5: "ne porte aucune trace de calotte". The fragility of these pollen grains was also emphasized in her paper. At the phylogenetical lineages of the recent *gymnosperm* pollen grains the *Larix* and *Pseudotsuga* together were mentioned as the most evolved type (M. VAN CAMPO, 1947b).

GULLVAG (1966) published TEM data of the *Pseudotsuga taxifolia* too. The exine ultrastructure of this species differs from those of *Larix decidua*. It is interesting that the exine ultrastructure of *Pseudotsuga taxifolia* is very similar to that of *Balmeiopsis limbatus* (BALME 1957) ARCHANGELSKY 1977 (KEDVES and PÁRDUTZ, 1974, KEDVES, 1994) and *Araucariacites hungaricus* DEÁK 1964 (KEDVES, 1985, 1994). The latter mentioned fossil forms represent early Mesozoic inaperturate pollen type.

In this way the combined experimental investigation of the pollen grains of the *Pseudotsuga* genus seems to be important. This paper is the first part within this research program.

Materials and Methods

The investigations material was collected by Á. ERDŐDI on 18.04.1996. Locality: Botanical Garden of the Department of Botany of J. A. University. The experiments were started on 21.04.1996. Temperature: 200°C, length of time and numbers of experiments are as follows: 0': 1/7-410, 10': 1/7-411, $1^{hr.}$: 1/7-412, $5^{hrs.}$: 1/7-413, $10^{hrs.}$: 1/7-414, $25^{hrs.}$: 1/7-415, $50^{hrs.}$: 1/7-416. The slides for light-microscopical investigations were mounted in glycerine-jelly hydrated at 39.6%. 200 specimens of each sample were qualitatively and quantitatively investigated. The pictures were taken with an objective Carl Zeiss Jena, GF Planachromat HI 100x/1.25/0.17-A.

Results

QUALITATIVE DATA

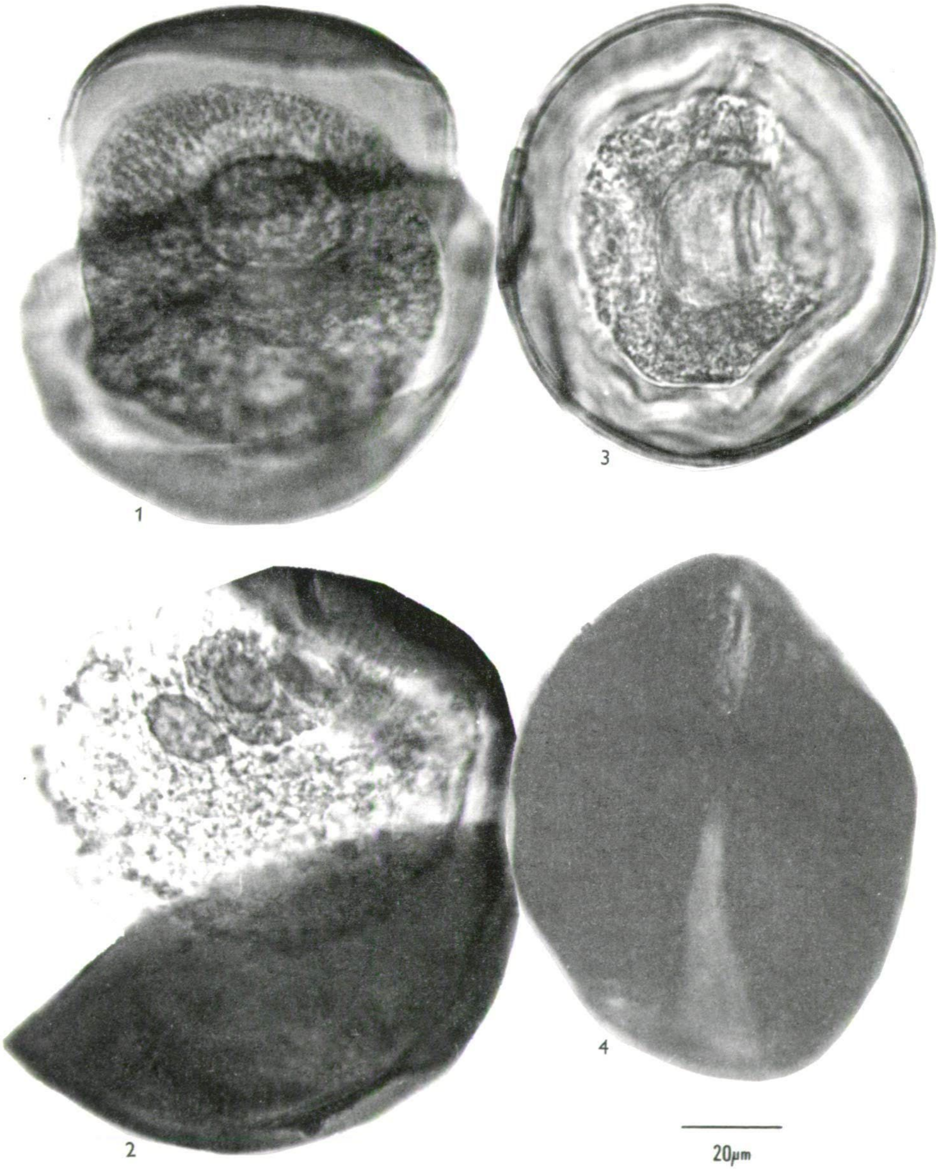
The observations on the fresh pollen grains of this species (Plate 7.1., figs. 1,2) support the results of M. VAN CAMPO (1947a), namely the fragility of the exine of these pollen grains. This pollen morphological characteristic feature results in several forms. The nuclei and the nucleoli are also well shown in our pictures. After 10' of heating (Plate 7.1., fig. 3) the protoplasm of the pollen grain contracts and/or the intine is swollen. In this way, the central nucleus is relatively very large. After $1^{hr.}$ of heating, the polar character of the pollen grains is also well shown in contrast to the fresh pollen grains. Monosulcate secondary forms also appeared after $5^{hrs.}$ of heating (Plate 7.1., fig. 4). The secondary forms after $25^{hrs.}$ of heating are similar to the above mentioned ones. After $50^{hrs.}$ of heating several non-spherical forms appeared secondariliy.

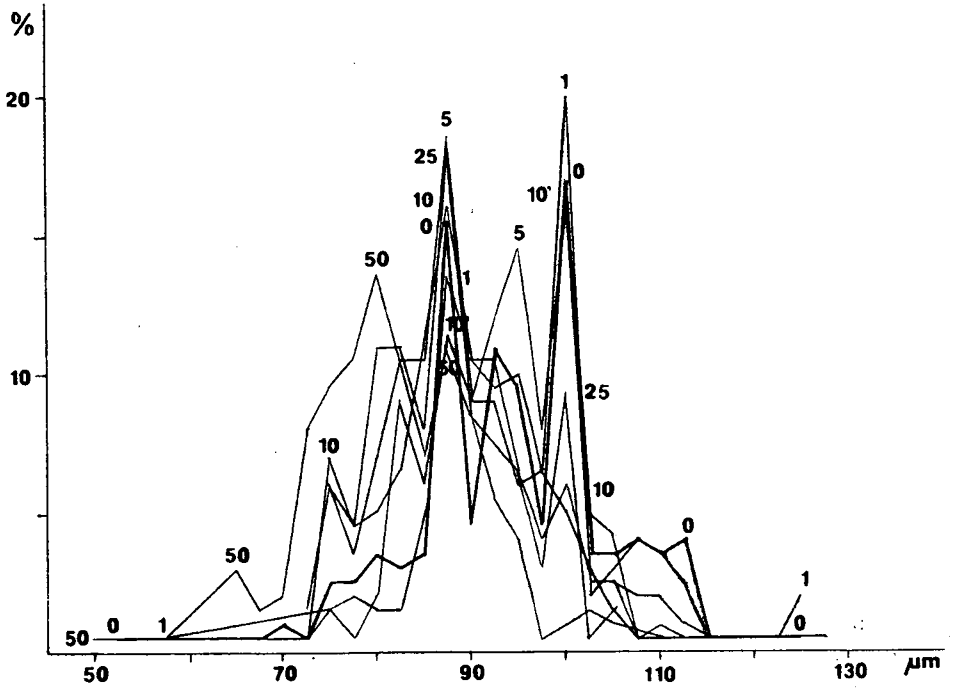
QUANTITATIVE DATA
(Text-figs. 7.1., 7.2.)

1. The pollen grains without heating are more or less spherical. Diameter: 52.5–122.5 µm, L/S ratio: 1.0–1.8. Dominant diameter: 87.5–100.0 µm, dominant ratio: 1.0–1.2.
2. After 10' of heating the diameter of the pollen grains have not increased in contrast to our previous general establishments. Diameter: 67.5–125.0 µm, L/S ratio: 1.0–1.5. Dominant diameter: 82.5–100.0 µm, dominant ratio: 1.0–1.2. Pollen grains of circular amb are more numerous than at the previously mentioned ones.

Plate 7.1.

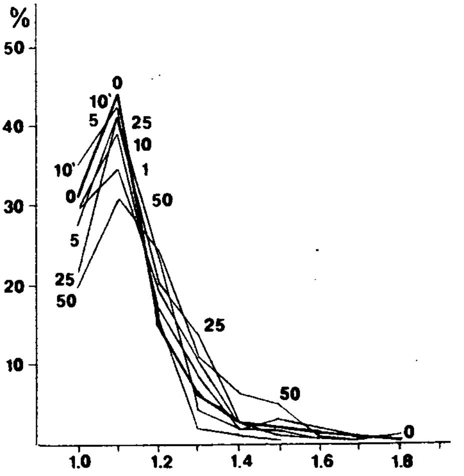
1–4. *Pseudotsuga menziesii* (MIRB.) FRANCO, Recent.
1,2. Pollen grains without heating; 1/7-410.
3. Experiment No: 1/7-411, length of time: 10 min.
4. Experiment No: 1/7-415, length of time: 25 hrs.


1
3
2
4
20µm



Text-fig. 7.1.

Pseudotsuga menziesii (MIRB.) FRANCO, Recent. Variation-statistical graphs of the longest size of the pollen grains.



Text-fig. 7.2.

Pseudotsuga menziesii (MIRB.) FRANCO, Recent. Variation-statistical graphs of the L/S ratio of the pollen grains.

3. After 1$^{hr.}$ the variation-statistical graph is very similar to that of the fresh pollen grains. The number of the spherical forms decreased. Diameter: 57.5–125.0 μm, L/S ratio: 1.0–1.7. Dominant diameter: 87.5–100.0 μm, dominant ratio: 1.0–1.3.

4. After 5$^{hrs.}$ of heating the contraction started. Diameter: 72.5–115.0 μm, L/S ratio: 1.0–1.6. Dominant diameter: 80.0–97.5 μm, dominant ratio: 1.0–1.2.

5. After 10$^{hrs.}$ of heating, the diameter: 72.5–127.5 μm, L/S ratio: 1.0–1.8. Dominant diameter: 75.0–100.0 μm, dominant ratio: 1.0–1.3.

6. After 25$^{hrs.}$ of heating. Diameter: 72.5–120.0 μm, L/S ratio: 1.0–1.6. Dominant diameter: 75.0–100.0 μm, dominant ratio: 1.0–1.3. The quantity of the spherical forms decreased in contrast to the previous ones.

7. After 50$^{hrs.}$ of heating. Diameter: 50.0–115.0 μm, L/S ratio: 1.0–1.8. Dominant diameter: 70.0–95.0 μm, dominant ratio: 1.0–1.5. The contraction of the pollen grains is very definite. The number of the non-spherical forms increased.

Discussion and Conclusions

In comparison to the results on the pollen grains of *Larix decidua* (BORBOLA, 1997) there are remarkable differences. For example the secondary monosulcate forms can be emphasized.

Hopingly the presented data will also be useful in the researches of the fossil forms.

Further experimental investigations are necessary, including the TEM method.

Acknowledgements

This work was supported by grant OTKA 1/7, T 014692. The author is deeply indebted to Prof. Dr. M. KEDVES for his valuable advices and to Miss Á. ERDŐDI for her technical assistance.

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8. HIGH TEMPERATURE EFFECT ON THE POLLEN GRAINS OF PLATANUS HYBRIDA BROT.

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Abstract

The LM results of the high temperature effect on fresh pollen grains of *Platanus hybrida* are summarized in this paper. The qualitative and the quantitative alterations are presented herein of the fresh and heated pollen grains at 200 °C during 10', 1 hr., 5, 10, 25 and 50 hours. The *Longaxones* characteristic features are more gradually expressed by the increasing lengthening of the time of heating. Short time heating resulted in swelling the pollen grains. Characteristic contraction was observed after 50 hours of heating. By the length of time of the heating, the P/E ration increases with several maxima from 1.3–1.6.

Key words: Palynology, recent, *Platanus hybrida*, high temperature effect.

Introduction

The pollen grains of the *Platanaceae* or *Platanus* type are important in the early evolution of the *angiosperm* pollen grains; cf. DOYLE and HICKEY (1976), DILCHER (1979), and KEDVES (1989). FRIIS and PEDERSEN (1996) carried out combined researches on in situ fossil *Platanus* pollen grains. SEM and TEM data of *Platananthus huberi* (Campanian, U.S.A.), SEM from *P. scanicus* (Santonian) (Campanian, Sweden). The electron dense endexine in the apertural area of *P. huberi* of non-lamellar ultrastructure can be pointed out.

Based on the work of ERDTMAN (1966) and THANIKAIMONI (1973), FRITZSCHE published the first data on the pollen grains of the *Platanus* genus in 1832. There are 69 bibliographical data of the *Platanus* pollen grains in the famous "Index bibliographique..." of the *angiosperm* pollen grains; THANIKAIMONI (1972, 1973, 1976, 1980, 1986), TISSOT (1990) and TISSOT and VAN DER HAM (1994).

During our experimental investigations of recent pollen grains the results of the high temperature effect are remarkable from an evolutionary point of view, too. As regards the earliest *Longaxones* types a short paper was published in 1993 (KEDVES, TÓTH, MÉSZÁROS, BORBOLA and AILER).

This contribution presents the first results of the combined studies on the *Platanus* pollen grains.

Materials and Methods

The pollen material was collected by Dr. M. KEDVES on 30.04.1996. Locality: Ujszeged, Park. The experiments were started on 02.05.1996. Temperature 200 °C, length of time and numbers of experiments are as follows. 0': 1/7-423, 10': 1/7-424, $1^{hr.}$: 1/7-425, $5^{hrs.}$: 1/7-426, $10^{hrs.}$: 1/7-427, $25^{hrs.}$: 1/7-428, $50^{hrs.}$: 1/7-429. The slides were mounted in glycerine-jelly hydrated at 39.6%. The pictures were taken with a Carl Zeiss Jena, objective GF Planachromat HI 100X/1.25/0.17-A.

Results

QUALITATIVE DATA

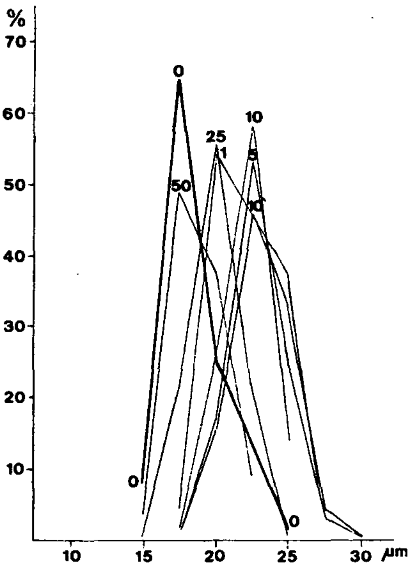
The fresh pollen grains, according to ERDTMAN (1966) are more or less isodiametric (=subprolate by ERDTMAN) and 3-colpate. The surface is finely reticulate. The pollen grains were observed several times in polar position (Plate 8.1., figs. 2,3), specimens, with typical *Longaxones* character are scarce (Plate 8.1., fig. 1). After 10' of heating (Plate 8.1., figs. 4,5), the expansion of the pollen grains is characteristic, without seeming alterations in the symmetry. After heating of $1^{hr.}$ (Plate 8.1., figs. 6,7) and $5^{hrs.}$ (Plate 8.1., figs. 8,9), the increased size is still remarkable, but the *Longaxones* character becomes more and more definite. Perceptible contraction started after $10^{hrs.}$ of heating (Plate 8.1., figs. 10–12), and endoaperture-like alterations were also observed (e.g.: the right specimen of fig. 12). Similar qualitative alterations were observed at the pollen grains after $25^{hrs.}$ of experiment (Plate 8.1., figs. 13,14). The *Longaxones*, the endoaperture-like characteristic features and the decrease in size of the pollen grains are well shown after $50^{hrs.}$ of heating (Plate 8.1., figs. 15,16).

QUANTITATIVE DATA

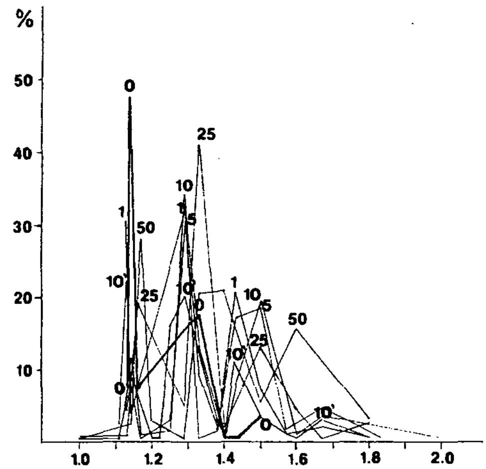
1. The alterations of the greatest size (polar axis) of the pollen grains are illustrated on Text-fig. 8.1. The swelling of the pollen grains after a short time of heating is characteristic. Regular alterations were established after experiments lasting for 10', $5^{hrs.}$ and $10^{hrs.}$. The maxima of the variation-statistical graphs of $1^{hr.}$ and $25^{hrs.}$ of heating are at the same value as of the fresh pollen grains. Characteristic contraction of shortening of the polar axis occurred after $50^{hrs.}$ of heating.

2. The variation-statistical graphs of the P/E ratio (Text-fig. 8.2.)
In general every variation-statistical graph has two or three maxima. The first maxima of experiments for 10' and $1^{hr.}$ are a bit minor than those of the fresh pollen grains. On the basis of our results, the real alterations are represented by the second or the last maximum of the graph. To this the P/E ratio of the experiment during $50^{hrs.}$ is very characteristic. The P/E values between 10 and 20 per cents may characterize the alterations at this kind of pollen grains.

Plate 8.1.



Text-fig. 8.1.
Platanus hybrida BROT. Recent. Variation-statistical graphs of the longest size of the pollen grains.



Text-fig. 8.2.
Platanus hybrida BROT. Recent. Variation-statistical graphs of the P/E ratio of the pollen grains.

Discussion and Conclusions

The taxonomical and phylogenetical importance of this kind of pollen grains was pointed out previously. To this, following IGLESIAS et al. (1993), JATO et al. (1996), and PEHLIVAN (1995) the pollen grains of the genus *Platanus* are allergenic. This is also a supplementary reason to the combined investigation of this kind of pollen grains. Regarding the nomenclature we cite the paper of JATO et al. (1996): *Platanus hispanica* MILLER ex MUNCH (= *Platanus hybrida* BROT.).

The basic morphology of these pollen grains of *Platanus hybrida* is mostly of early character, the tricolpate germinal area, and the finely reticulate sculpture. But the nearly isodiametric symmetry is not fully concordant with the above mentioned characteristics. Taking into consideration our previous results of the high temperature effect of *Longaxones angiosperm* pollen grains the alteration of the P/E ratio is a little different than at the previously investigated species. Further experimental investigations on this pollen material are in progress.

Plate 8.1.

1–16.	*Platanus hybrida* BROT. Recent.
1–3.	Pollen grains without heating; 1/7-423.
4,5.	Experiment No: 1/7-424, length of time: 10 min.
6,7.	Experiment No: 1/7-425, length of time: 1 hr.
8,9.	Experiment No: 1/7-426, length of time: 5 hrs.
10–12.	Experiment No: 1/7-427, length of time: 10 hrs.
13,14.	Experiment No: 1/7-428, length of time: 25 hrs.
15,16.	Experiment No: 1/7-429, length of time: 50 hrs.

Acknowledgements

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9. X-RAY EFFECT ON THE LM MORPHOLOGY OF SOME ANGIOSPERM POLLEN GRAINS I.

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Abstract

The alterations of the LM morphological characteristic features in consequence of X-ray irradiation were investigated at the following species: 1. Brevaxonate *dicotyledonous* pollen grains: *Plantago lanceolata, Carya illinoensis, Juglans nigra, Platycarya strobilacea.* 2. Monosulcate *monocotyledonous* pollen grains: *Hemerocallis lilio-asphodelus.* Among the new results presented herein, the extreme resistance to the X-ray irradiation of the pollen grains of *Platycarya strobilacea* may be pointed out.

Key words: Palynology, *angiosperm,* X-ray effect, light microscopy.

Introduction

Within this research program of our Laboratory the aim of this part is the following:

1. Three pollen types of *Juglandaceae* (*Juglans, Carya, Platycarya*), because the same genuses were investigated by partial dissolution of the biopolymer system of the exine.
2. Another point of view was the morphology of the pollen grains in the selection of the experimental material. The pollen grains of the genus *Plantago* represent periporate spherical form. The *Hemerocallis* type pollen grains is one of the earliest *angiosperm* forms. The monosulcate, monocolpate type, as it is well known, occur among the *gymnosperms* and *angiosperms* also, including the *dicotyledonous* and *monocotyledonous* taxa.

Materials and Methods

The data of the investigated species are the following:

Plantago lanceolata L.

Locality: Újszeged the left river-side of Tisza. Collected: Á. KÁROSSY, on 24.05.1995. Irradiation: on the 31.05.1995, LM investigation: on the 03.06.1995.

Carya illinoensis (WANG.) K. KOCH

Locality: Botanical Garden of the J. A. University. Collected: I. GÁSPÁR, on 27.05.1995. Irradiation: on the 30.05.1995, LM investigation: on the 03.06.1995.

Juglans nigra L.

Locality: Botanical Garden of the J. A. University. Collected: I. GÁSPÁR, on the 20.05.1995. Irradiation: on the 24.05.1995, LM investigation: on the 24.05.1995.

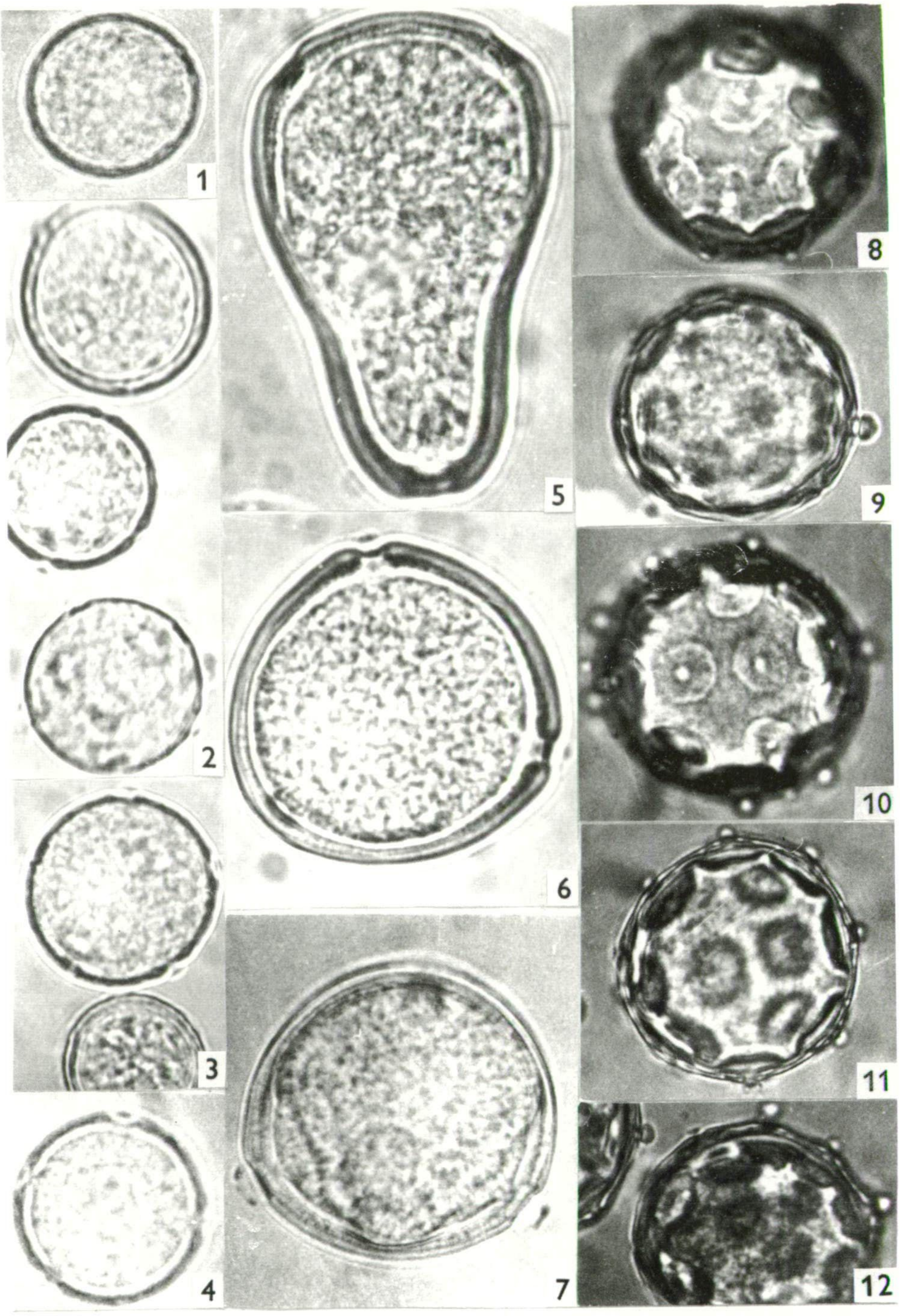

Plate 9.1.

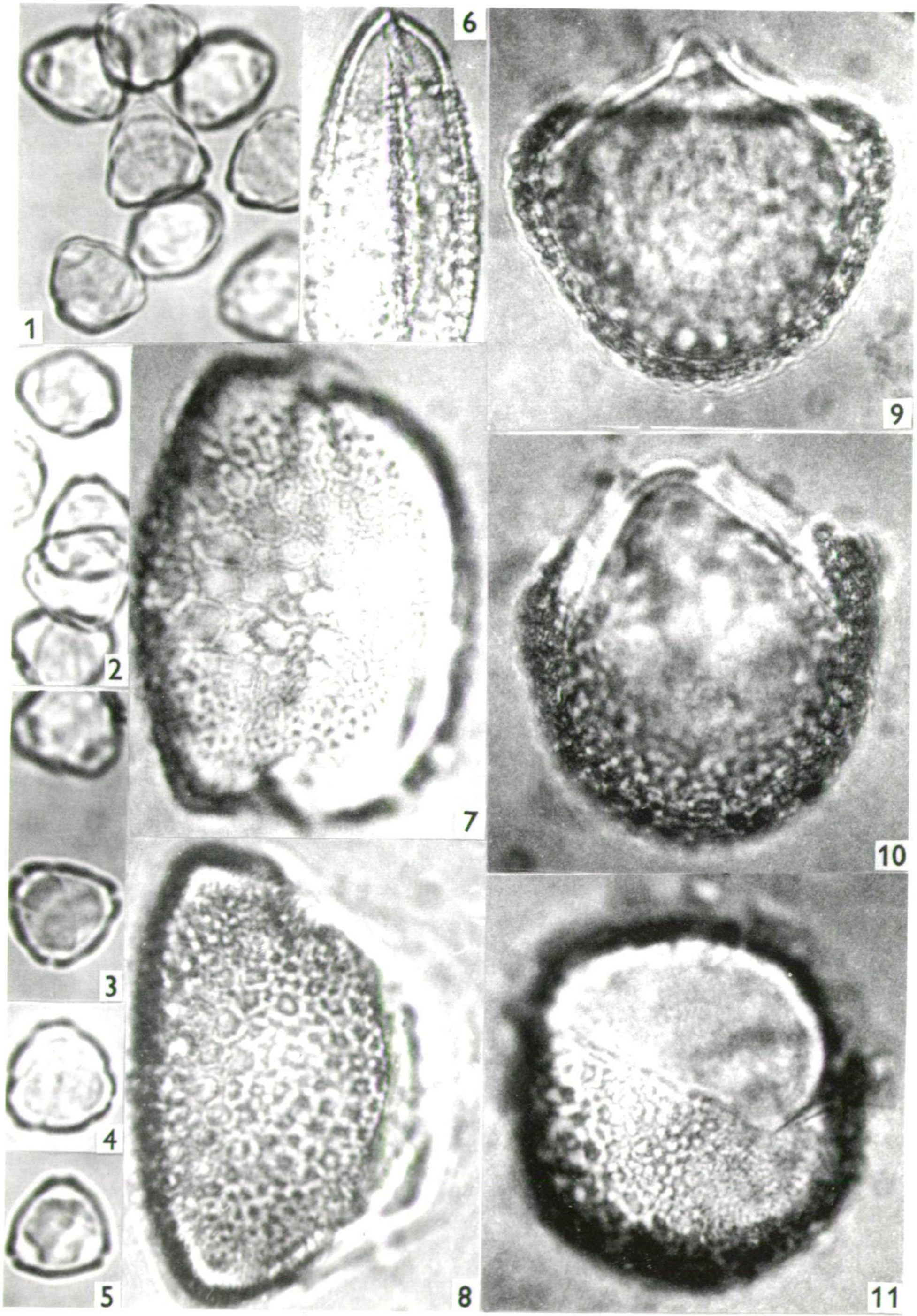

Plate 9.2.

Platycarya strobilacea SIEB. et ZUCC.

Locality: Botanical Garden of the J. A. University. Collected: I. GÁSPÁR, on 10.05.1995. Irradiation: on the 13.06.1995, LM investigation: on the 30.06.1995.

Hemerocallis lilio-asphodelus L. em. SCOP.

Locality: Botanical Garden of the J. A. University. Collected: Á. KÁROSSY, on the 24.05.1995. Irradiation: on the 01.06.1995, LM investigation: on the 05.06.1995.

Irradiations were made with a BRON-OM1 apparatus in the Radiological Laboratory of the Department of Mineralogy, Petrology and Geochemistry of the J. A. University, Szeged. Radiation data: 35KV, 20 mA, CuKα beam. Length of irradiation: 35'.

Results

Plantago lanceolata L. (Plate 9.1., figs. 1–4)

The pollen tube development in consequence of the X-ray irradiation at all apertures was observed at 50.0% (Plate 9.1., figs. 3,4). Partial pollen tube development was observed at 20.3% of the investigated pollen grains (Plate 9.1., fig. 2). A remarkable per cent (29.5) of the pollen grains are non-altered (Plate 9.1., fig. 1).

Carya illinoensis (WANG.) K. KOCH (Plate 9.1., figs. 5–7)

It is interesting that at this species the majority (89.0%) of the investigated pollen grains was non-altered (Plate 9.1., fig. 1). This form is "Siamense twin" aberrant. Partial pollen tube development was observed at 8.5% (Plate 9.1., fig. 6). Total pollen tube development occurred at 2.5 per cent of the investigated pollen grains (Plate 9.1., fig. 7).

Juglans nigra L. (Plate 9.1., figs. 8–12)

At this kind of pollen grains it was not so easy to establish in several cases whether the pollen tube development is total or partial. But according to present observations 34.0% of the pollen grains the pollen tubes were totally developed (Plate 9.1., figs. 11, 12). 48.0% were partially developed (Plate 9.1., fig. 9). Finally 18.0 per cent were non-altered (Plate 9.1., fig. 8).

Platycarya strobilacea SIEB. et ZUCC. (Plate 9.2., figs. 1–5)

As a surprising result 100.0 per cent of the investigated pollen grains were non-altered.

Hemerocallis lilio-asphodelus L. em. SCOP. (Plate 9.2., figs. 6–11)

At the greatest part of the irradiated pollen grains (65.0%) was totally developed (Plate 9.2., figs. 8–11). 11.5% represent the partially developed pollen tube of the irradiated pollen grains (Plate 9.2., figs. 7,8). 23.5 per cent of the investigated pollen grains were non-altered (Plate 9.2., fig. 6).

Plate 9.1.

1–4. *Plantago lanceolata* L., Recent, Experiment No: 1/7–174.
5–7. *Carya illinoensis* (WANG.) K. KOCH, Recent, Experiment No: 1/7–172.
8–12. *Juglans nigra* L., Recent, Experiment No: 1/7–124. 1.000x.

Plate 9.2.

1–5. *Platycarya strobilacea* SIEB. et ZUCC., Recent, Experiment No: 1/7–248.
6–11. *Hemerocallis lilio-asphodelus* L. em. SCOP., Recent, Experiment No: 1/7–177. 1.000x.

Discussion and Conclusions

The heterogeneous character of the pollen grains of *Juglandaceae* from the point of view of evolution was emphasized earlier (KEDVES, 1989). The resistance of the pollen grains of the genus *Juglans* to high temperature was established by KEDVES and KINCSEK (1989). These pollen grains are resistant also to organic solvents, cf. KEDVES, KÁROSSY and BORBOLA (1996). To this the resistance of the pollen grains of the genus *Platycarya* may be added.

Regarding the monosulcate (monocolpate) pollen grains we can point out the pollen tube development of 65.0% in consequence of X-ray irradiation at *Hemerocallis lilio-asphodelus*, in contrast to the previously investigated *Magnolia kobus* (KEDVES and UNGVÁRI, 1995). At this latter mentioned species this phenomenon was observed at 9.6% of the pollen grains. The importance of the monosulcate (monocolpate) pollen grains is well known. Further, multidisciplinary investigations are necessary to have sufficient data to establish general conclusions in every respect.

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10. X-RAY EFFECT ON THE ULTRASTRUCTURE OF THE POLLEN GRAINS OF GINKGO BILOBA L.

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Abstract

Pollen grains of *Ginkgo biloba* L. were irradiated with CuKα X-ray at 35 KV, 20 mA. Length of time of irradiations were as follows: 5', 15', 35' and 60'. The biopolymer system of the ectexine is relatively resistant to the irradiation, sub-units were not observed. Desintegration in the ultrastructure was observed in the first place at the intine and the endexine. In the apertural region degradation of the foot layer was also observed.

Key words: Palynology, recent, *Ginkgo biloba*, X-ray effect, TEM.

Introduction

The monosulcate/monocolpate LM morphology of the pollen grains of *Ginkgo biloba* L. has been well known for a long time together with the similarity to some *Cycadales* and *Palmales* genuses. KEDVES (1961) discussed the morphology and the problems of the botanical affinities of the fossil forms. First TEM data were published by UENO (1960). AUDRAN and MASURE (1978) described in detail the fine structure of the different layers of the exine. The lamellar ultrastructure of the sexine and its occurrence in the germinal area is a very important contribution to the fine structure morphology of these pollen grains. WANG (1989) emphasized, that his observations confirm the results of UENO (1960) and of AUDRAN and MASURE (1978). In 1990 WANG pointed out that it is difficult to distinguish pollen grains of *Ginkgo* from that of *Cycadales* in the light-microscope, but ultrastructurally they are quite different. Foot layer is distinct and the endexine is lamellated. Following XI and WANG (1989) and XI (1990) the endexine of the pollen grains of *Ginkgo biloba* is very thin, 2-3 lamellate with indistinct boundaries between lamellae.

During our investigations of the X-ray effect to the sporomorphs the alterations of the LM morphology of the pollen grains of *Ginkgo biloba* were also published (KEDVES and GÁSPÁR, 1995). This paper presents the TEM results of the X-ray irradiated pollen grains.

The aim of this paper is in the first place whether the alterations in the LM morphology aren't connected with ultrastructural desintegrations.

Materials and Methods

Locality: Újszeged, Garden of the Biological Centre of the Hungarian Academy of Sciences. Collected: I. GÁSPÁR on 22.04.1992. Irradiation: on the 05.08.1993, with a BRON-OM1 apparatus in the Radiological Laboratory of the Department of Mineralogy, Petrology and Geochemistry of the J. A. University, Szeged. Radiation data: 35 KV, 20 mA, CuKα beam. Length of time and numbers of experiments: 5' 1731, 15' 1732, 35' 1733, 60' 1734. The irradiated pollen grains were postfixed with 1% OsO_4 aquous dilution and embedded in Araldite. The ultrathin sections were made at the Hungarian Academy of Sciences Biological Research Center EM Laboratory on a Porter Blum ultramicrotome. The TEM photographs were taken on an Opton EM-902 (resolution 2-3 Å), and on a Tesla BS-540 (resolution 5 Å).

Results

The ultrastructure of the non-experimental fresh pollen grains for comparison is represented in Plate 10.1., figs. 1–5. Illustrated are: the thick tectum, the peculiar, more or less columellar infratectal layer, the thin foot layer, the lamellar endexine, in particular at the bordering of the apertural and inter-apertural area, the intine and the protoplasm.

Experiment No: 1731 (Plate 10.2., figs. 1–4). – The originally finely lamellar intine desintegrated or disappeared, e. g.: figs. 2, 4 in Plate 10.2. There are also alterations at the characteristic lamellae of the endexine, but the elements are discernible. The substance and the ultrastructure of the ectexine layers have not been altered.

Experiment No: 1732 (Plate 10.3., figs. 1–5). – The desintegration of the endexine and intine progressed. In the inter-apertural area, in several places it is not so easy to distinguish the endexine from the foot layer, cf. fig. 1, in Plate 10.3. The elements of the peculiar infratectal layer are well illustrated in the above mentioned picture.

Experiment No: 1733 (Plate 10.4., figs. 1–3). – Cross-sectional picture of the pollen grain well illustrate the general morphology of this kind of pollen grain. Sulcus and colpus are together. Sulcus is as it was illustrated by ERDTMAN (1957), the ultrastructure of the colpus as it was published by ROLAND (1968). Worth of mentioning is, the presence of microbial organisms, mostly fungi in the "sulcus hole." The desintegration of the inner layers continued (Plate 10.4., figs. 2,3), this is very characteristic in the colpus.

Experiment No: 1734 (Plate 10.5., figs. 1–6). – The desintegration of the protoplasm is characteristic (Plate 10.5., fig. 1). The intine is completely or partially destroyed. The lamellae of the endexine are relatively well preserved (Plate 10.5., figs. 4–6). In our material the number of the lamellae near the colpus is four and two in the bordering area. The ectexine in the extra-apertural region is not desintegrated the foot layer and the endexine in the apertural area are damaged only (Plate 10.5., figs. 2,5).

Discussion and Conclusions

Based on our up-to-date knowledges we can concluded the following:

1. The biopolymer system of the ectexine of the pollen grains of *Ginkgo biloba* L. is very resistant to X-ray irradiation. In contrast to the previous observations on the pollen grains of *Alnus glutinosa* (L.) GAERTN., cf. KEDVES and PÁRDUTZ (1992).

Biopolymer subunits were not discovered in the ectexine, desintegration was observed only in the colpus area.

2. Desintegration was observed in the first place at the inner part of the wall. The finely lamellar ultrastructure of the intine is very easily destroyed. Alterations were observed in the lamellar ultrastructure of the endexine in the apertural area.
3. The morphological terms sulcus and colpus may be discussed at these pollen grains. To this the basic work of ERDTMAN (1957) and ROLAND (1968) may be pointed out.
4. The presence of the microbial organisms, in the first place of *Fungi*, is interesting in the sulcus hole. These organisms may contribute to several further alterations.

4.1. Microbial, enzymatic desintegration may be supposed in the apertural area, in the colpus region.

4.2. It can be taken into consideration at the pollen allergological studies that the surface of pollen grains can be covered and transported microscopical *Fungi* and other organisms which can also be factors of the allergological symptomes.

Acknowledgements

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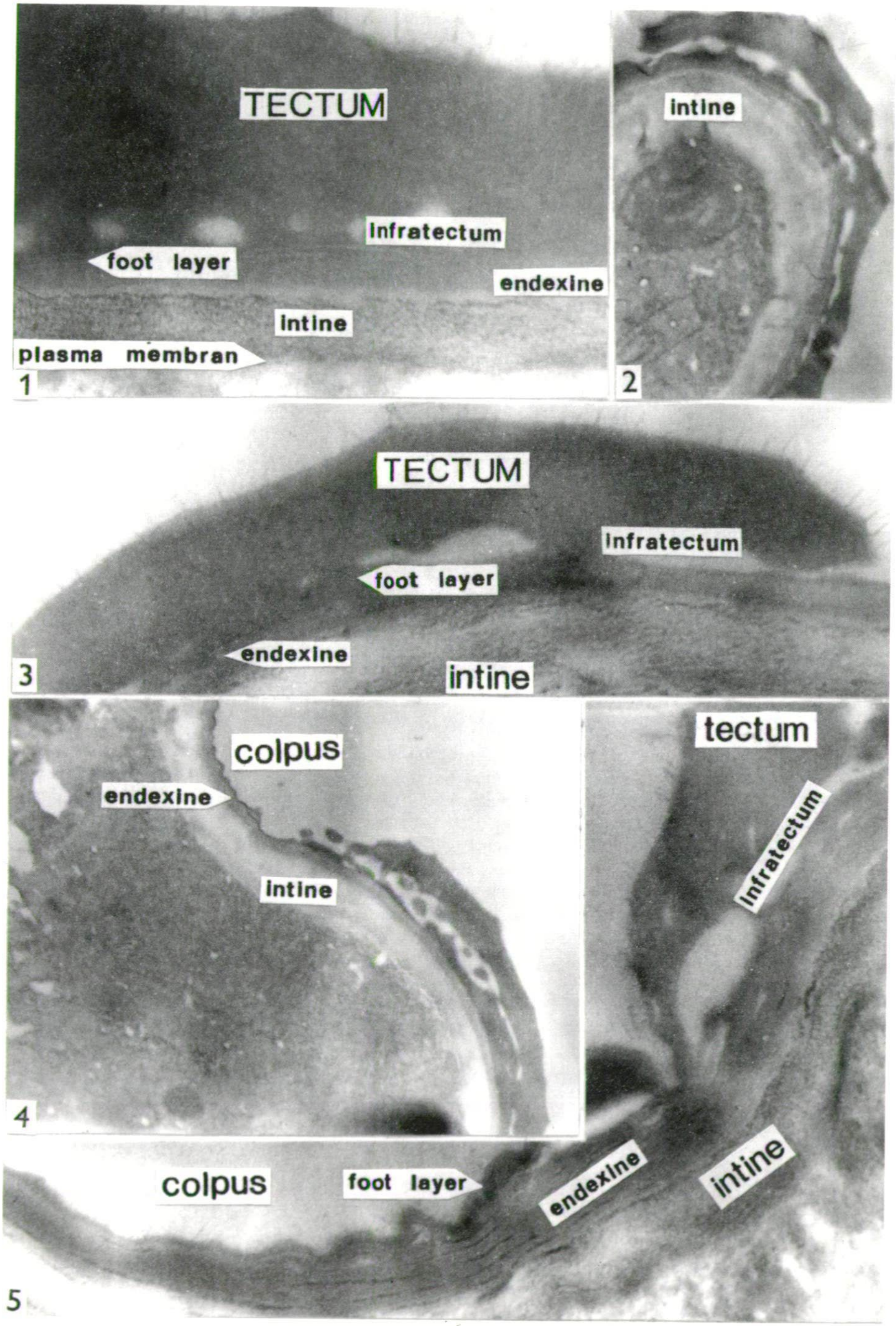
TECTUM
infratectum
foot layer
endexine
intine
plasma membran
1
intine
2
TECTUM
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endexine
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3
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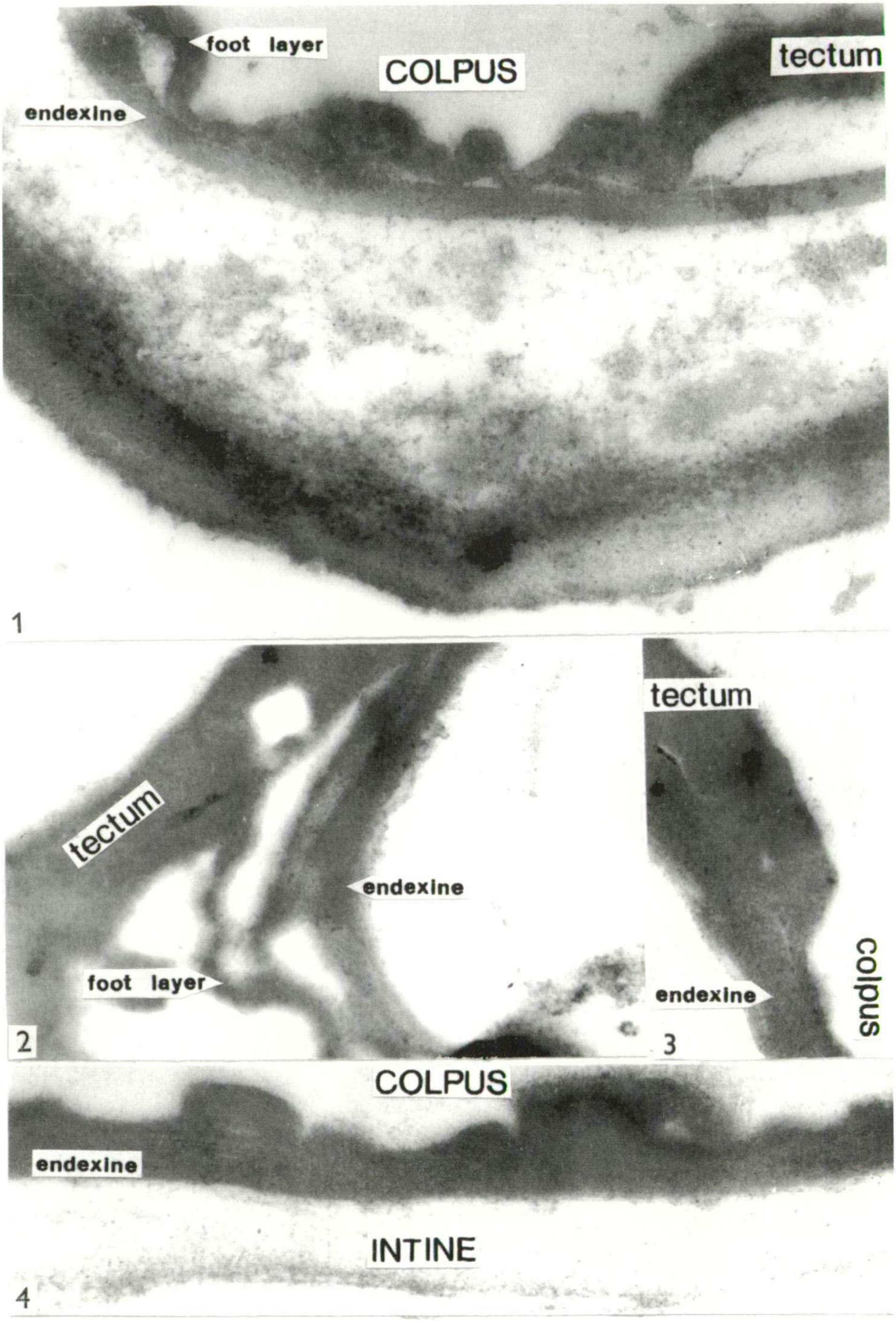
5

Plate 10.1.


foot layer
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INTINE
4

Plate 10.2.

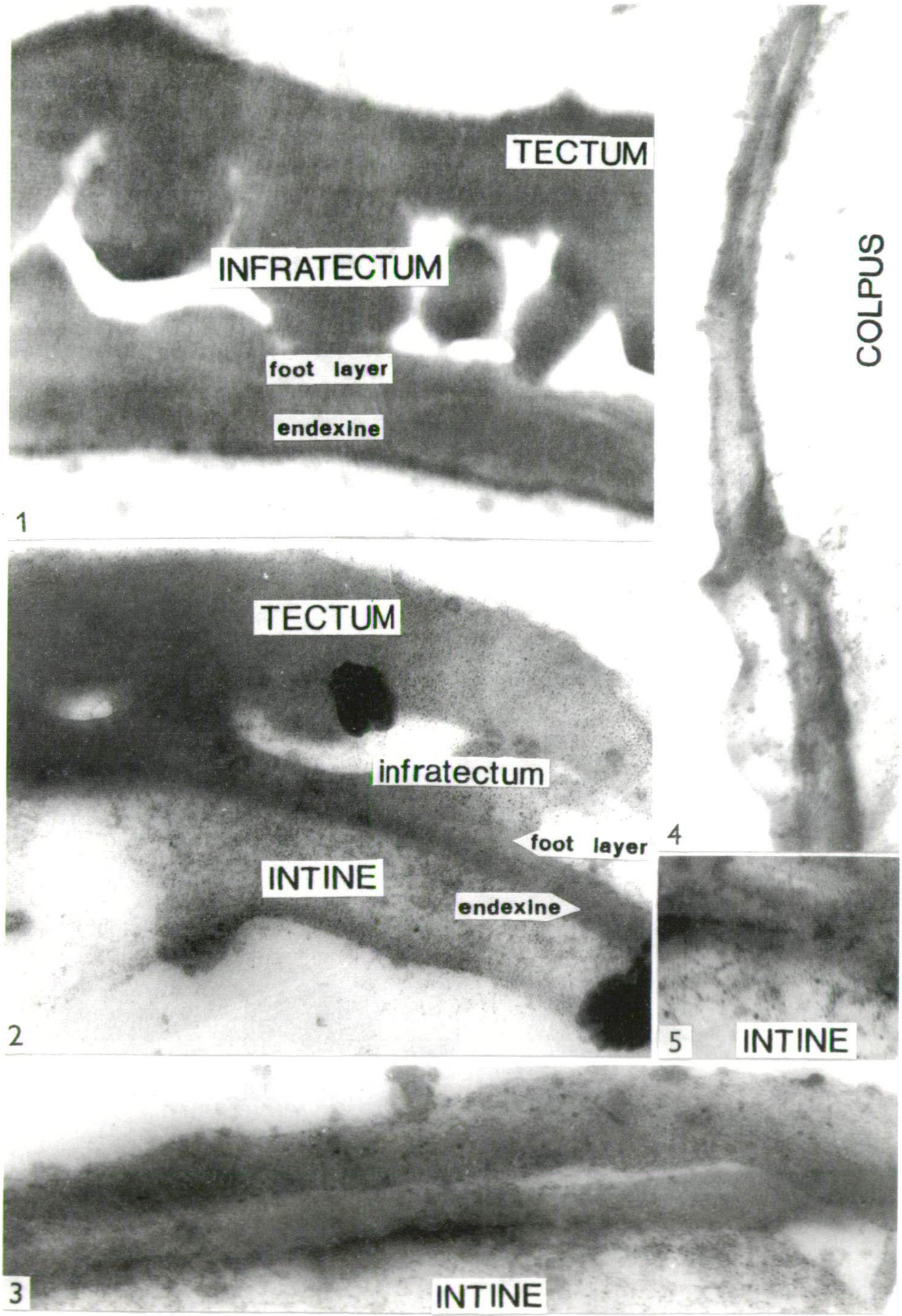
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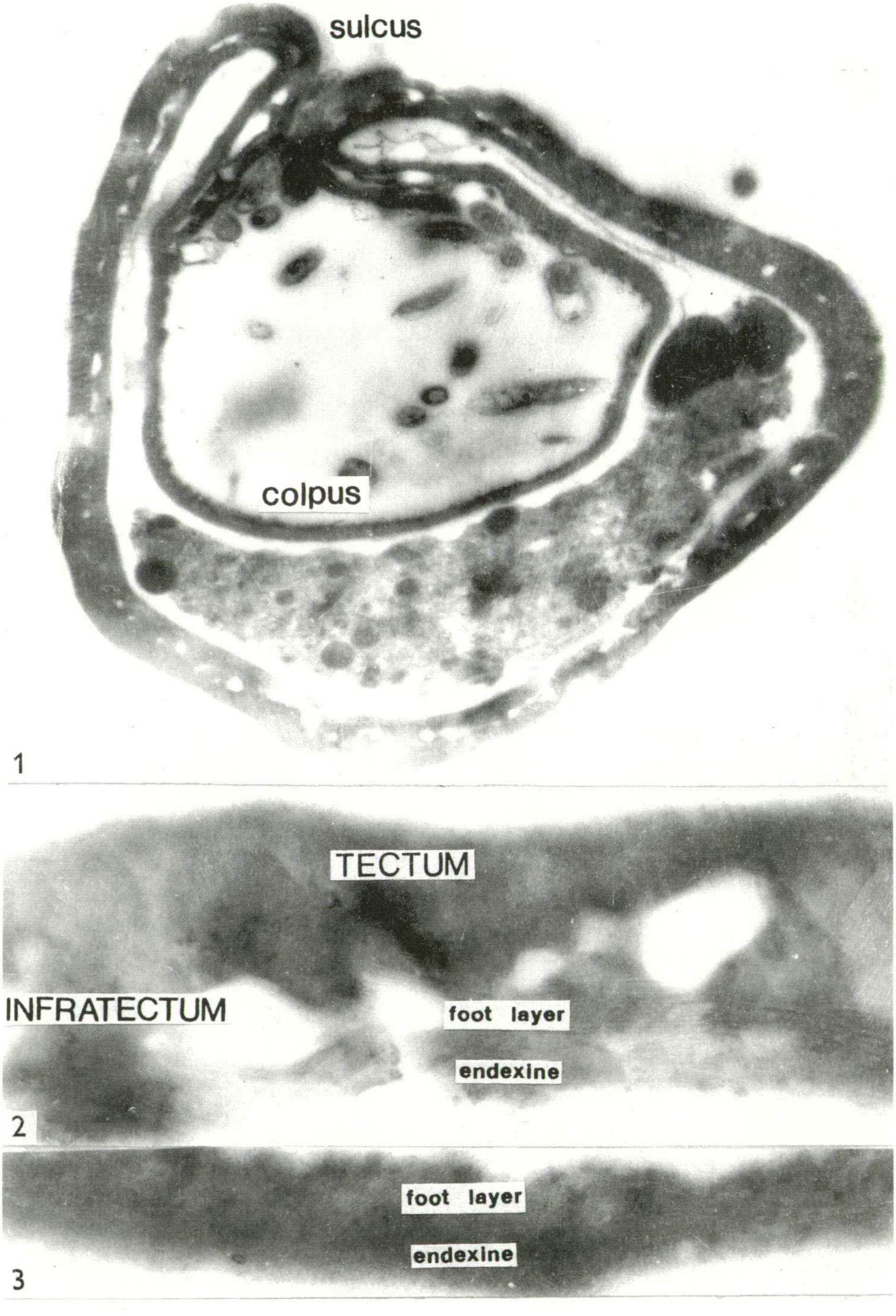
Plate 10.3.


sulcus
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endexine
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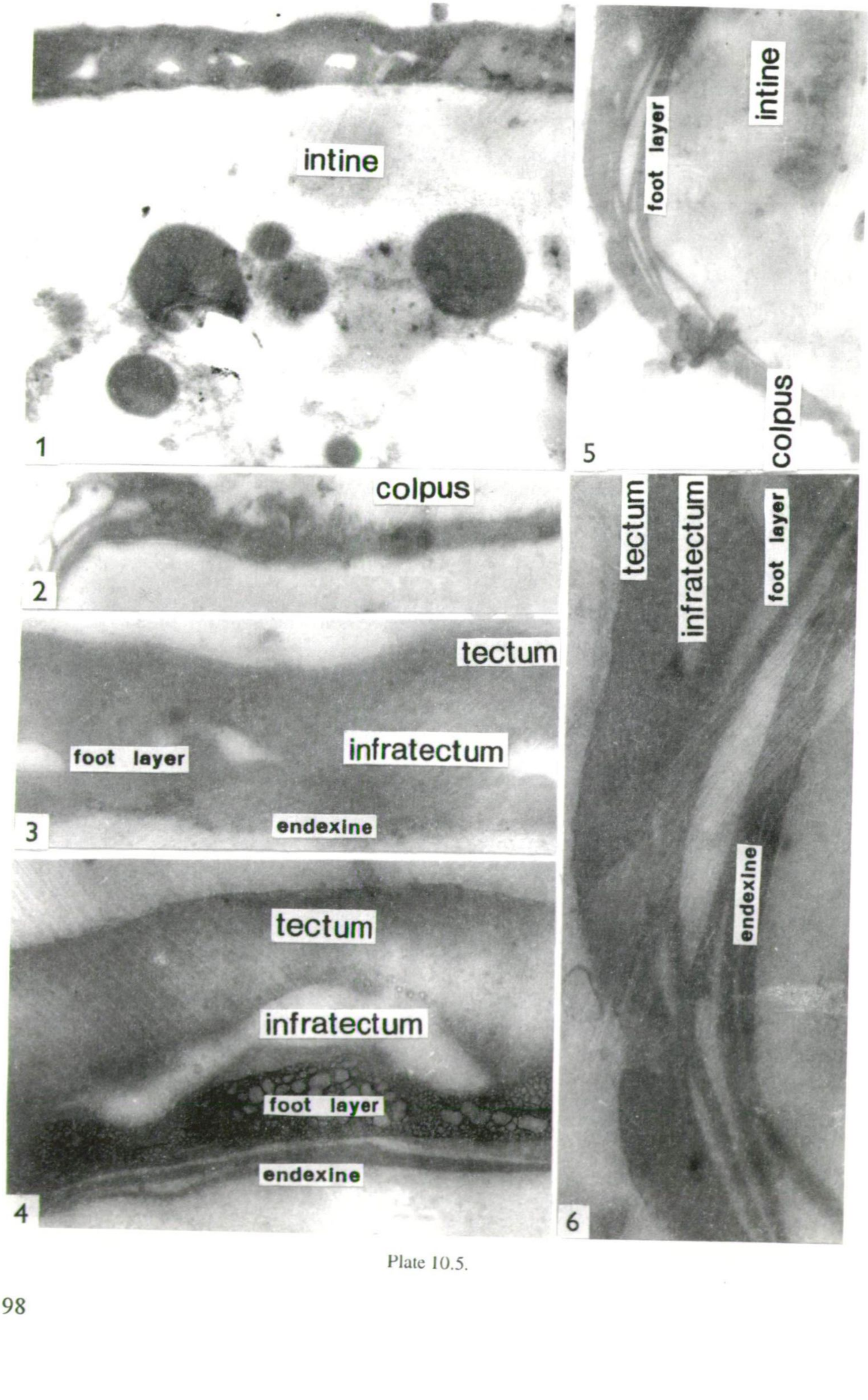
Plate 10.4.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endexine
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infratectum
foot layer
endexine
6
tectum
infratectum
foot layer
endexine

Plate 10.5.

Plate 10.1.

1–5. *Ginkgo biloba* L. Recent. Ultrastructure of the non-experimental fresh pollen grains.
1. Detail of the exine ultrastructure of the inter-apertural area. 50.000x.
2. General survey picture of the ultrastructure of the pollen grains in the inter-apertural area. The relatively large nucleus is well shown. 10.000 x.
3. Detail of the exine ultrastructure near the apertural area. The finely lamellar ultrastructure of the intine are illustrated. 25.000 x.
4. General survey picture of the pollen grain in the apertural area. 10.000 x.
5. Detail of the exine ultrastructure in the apertural area. Worth of mentioning is the thin foot layer in the colpus region, and the endexine lamellae in the bordering area of the colpus. 50.000 x.

Plate 10.2.

1–4. *Ginkgo biloba* L. Recent. Experiment No: 1731.
1. Ultrastructure of the pollen grain at the bordering of the apertural area. Negative no: 6027. 50.000 x.
2. Characteristic lamellar endexine in the bordering of the apertural area. Negative no: 6024. 50.000 x.
3. Bordering of the inter-apertural and apertural area. Negative no: 6025. 50.000 x.
4. Ultrastructure of the colpus. The degradation of the ultrastructural elements of the endexine and in particular of the intine is well shown. Negative no: 6025. 50.000 x.

Plate 10.3.

1–5. *Ginkgo biloba* L. Recent. Experiment No: 1732.
1. Detail of the exine ultrastructure of the inter-apertural area. Illustrated are the thick tectum, the peculiar infratectal layer, the thin foot layer and the damaged endexine. Negative no: 6032. 50.000 x.
2. Detail of the exine ultrastructure near the apertural area. The degradation of the ultrastructural elements of the intine is well shown. Negative no: 6033. 50.000 x.
3. Detail of the exine ultrastructure in the colpus region. Negative no: 6030. 50.000 x.
4. General survey picture of the exine ultrastructure in the colpus area. Negative no: 6031. 25.000 x.
5. Detail of the degraded endexine and intine. Negative no: 6029. 50.000 x.

Plate 10.4.

1–3. *Ginkgo biloba* L. Recent. Experiment No: 1733.
1. General survey picture of the cross-section of the pollen grain. The different kinds of microorganisms in the sulcus hole are well shown. Negative no: 6039. 10.000 x.
2. Detail of the exine ultrastructure in the inter-apertural area. Negative no: 6037. 50.000 x.
3. Detail of the exine ultrastructure in the colpus region. Negative no: 6038. 50.000 x.

Plate 10.5.

1–6. *Ginkgo biloba* L. Recent. Experiment No: 1734.
1. General survey picture of the pollen grain in the inter-apertural area. Negative no: 6012. 15.000 x.
2. Detail of the exine ultrastructure in the apertural area. Negative no: 6015. 15.000 x.
3. Detail of the ectexine ultrastructure in the inter-apertural area. Negative no: 6013. 50.000 x.
4. Detail of the ectexine ultrastructure near the bordering of the apertural area. Two lamellae of the endexine are well shown. Negative no: 6018. 50.000 x.
5. General survey picture of the pollen grain at the bordering of the apertural area. Rectification: foot layer properly endexine. Negative no: 6014. 15.000 x.
6. Detail of the lamellar endexine in the bordering area of the aperture. The four lamellae are segregated. Negative no: 6019. 50.000 x.

11. COMPUTER MODELLING OF THE QUASI-CRYSTALLOID BIOPOLYMER STRUCTURE III.

M. KEDVES and L. KEDVES

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Abstract

This contribution deals with the computer modelling of a lamella composed of pentagon dodecahedrane units. The method is the following: 1. The lamella was presented and investigated by a perspective drawing. 2. Four building elements were leaved. 3. Superficial skeletal network together the points of symmetry of the edges and without network are represented. 4. Each, three kinds of points of symmetry are illustrated with skeletal network and without network. The configuration of the different kinds of points of symmetry may be useful in the interpretation of the TEM pictures of partially desintegrated superficial and lamellar biological elements.

Key words: Lamellar biological structure, computer modelling.

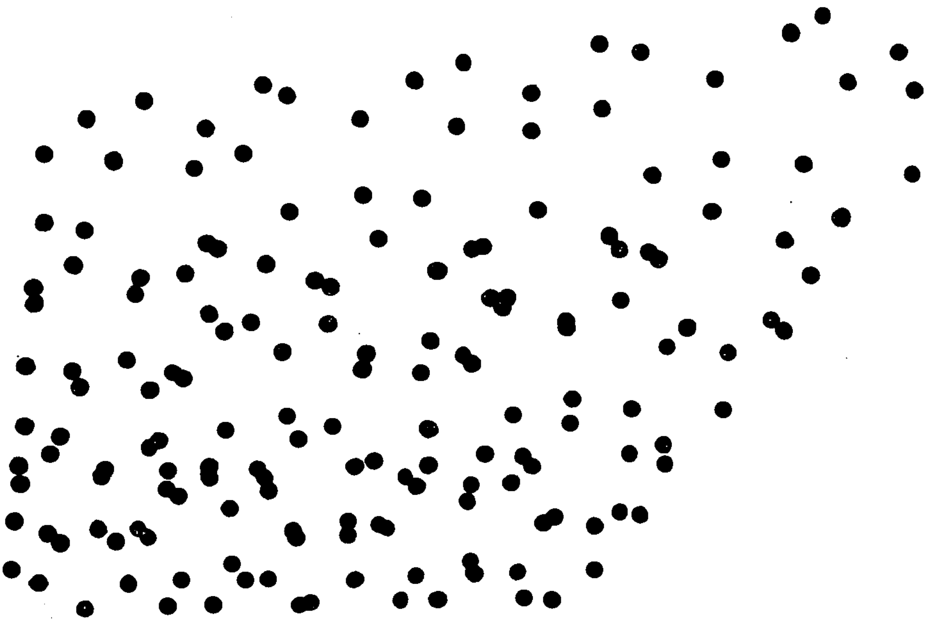
Introduction

The surfaces, and in general the bordering systems of inorganic and organic structures have their peculiarities on atomic or molecular level. Lamellar structures occur very often in several kinds of cellular elements of the living structures not only in the wall, but in the protoplasm also. The presence of the quasi-crystalloid biopolymer structure was demonstrated previously in the plant cell wall (cf. KEDVES 1988, 1989, 1990 etc.) as one kind of component of the extremely complicated molecular and biopolymer system. The aim of this contribution is to furnish computer data to the interpretation of the points of symmetry of the TEM pictures of partially degraded or dissolved biological objects.

Materials and Methods

In our previous papers (1994, 1995) we elaborated our basic methods and symbols of the computer modelling of the quasi-crystalloid biopolymer systems. We investigated the following characteristic features:

1. The superficial network and the points of symmetry of the edges of the pentagon.
2. The points of symmetry of the edges, the centrum of the planes and the centrum of the pentagon dodecahedrane elementary units.



Text-fig. 11.2.

Points of symmetry of the superficial edges of the pentagon dodecahedrane building units without network.

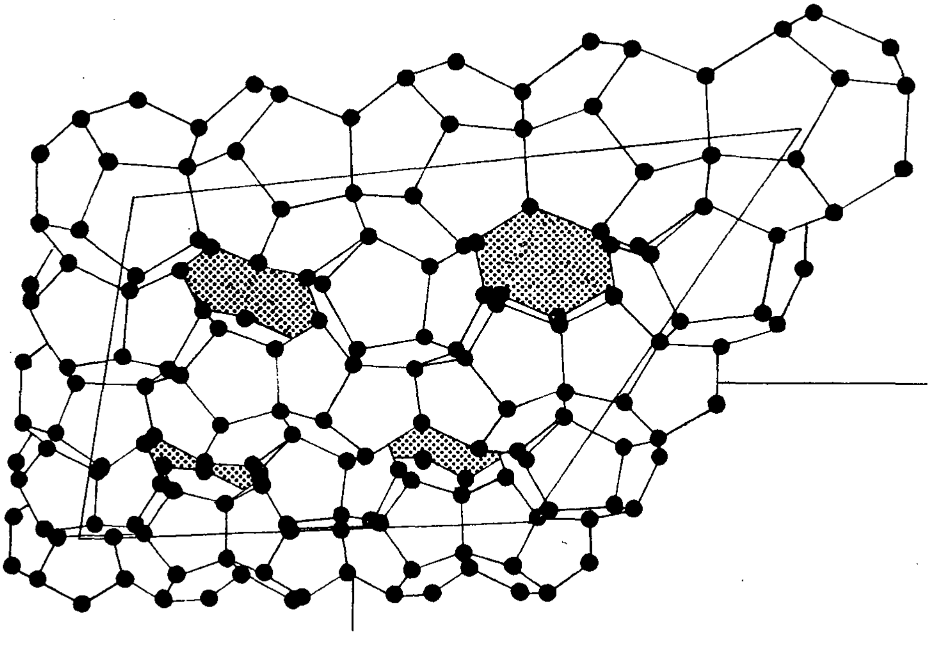
2. The computer modelling of the uni-layered lamella composed pentagon dodecahedrane elementary units.

Text-fig. 11.3. represents the quasi-crystalloid network, and each point of symmetry. Several kinds of configuration may be discernible. It is well shown that around the absent pentagon dodecahedrane units, the surrounding central stabilizing units form hexagonal patterns. The points of symmetry without network (Text-fig. 11.4.) are interesting. The holes of the leaved quasi-crystalloid units are well shown. Linear arrangement of all three kinds of points of symmetry is characteristics. And because of the great number of the points of symmetry it is extremely difficult to recognize the pentagonal arrangement of the points of symmetry. This is noteworthy in particular at the points of symmetry of the edges of the pentagonal planes.

Results

1. The superficial points of symmetry of the edges of the pentagon dodecahedrane elementary units.

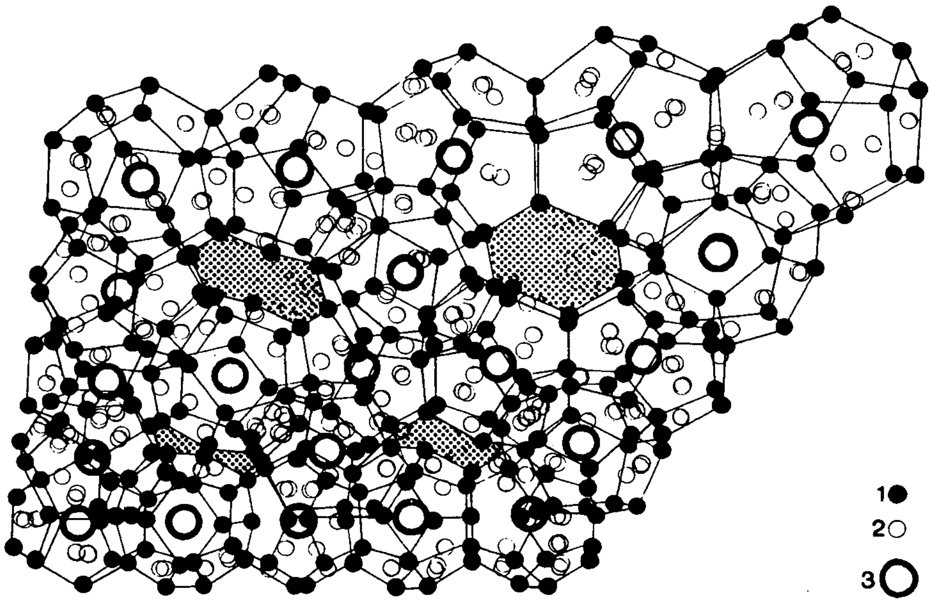
Text-fig. 11.1. illustrates the superficial network and the four leaved pentagon dodecahedrane units are dotted. The parameters of the perspective drawing are also illustrated. Without network (Text-fig. 11.2.) the points of symmetry of the superficial edges illustrate as follows. 1.1. The lack of the four superficial pentagons are not



Text-fig. 11.1.

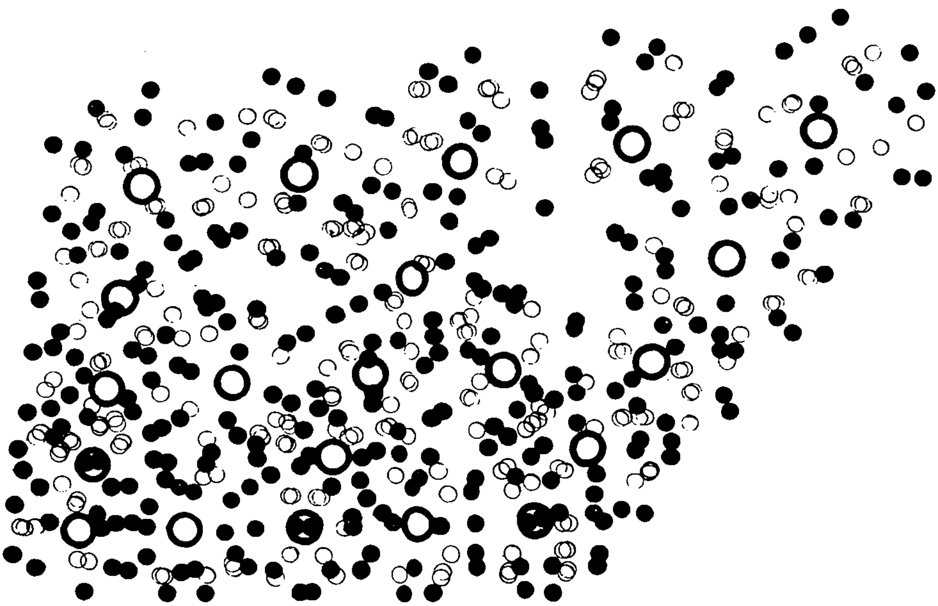
Computer model of the superficial network of the unilayered lamella represented by perspective drawing. The superficial edges of the quasi-crystalloid skeleton are illustrated. The holes of the four leaved building units are dotted.

conspicuous. 1.2. The accumulation of the points of symmetry in pairs of different kinds of triplicate may also occur in the TEM pictures of the partially degraded biopolymer systems. 1.3. The pentagons of the planes of the quasi-crystalloid skeleton, in consequence of the extremely different orientations are not always discernible. Apparently tetragons and hexagons may also occur.



Text-fig. 11.3.

Computer model of the unilayered lamella composed of pentagon dodecahedrane building elements. Legends: 1 – points of symmetry of the edges of the pentagon dodecahedrane unit. 2. The centres of the regular pentagon planes. 3. The centrum of the pentagon dodecahedrane unit.



Text-fig. 11.4.

Points of symmetry of the previous text-fig. without network.

Discussion and Conclusions

Based on our up-to-date knowledge we can establish the following:

1. The computer modelling together with the previously applied different kinds of two and three-dimensional modelling of the biopolymer systems of the plant cell wall furnish by and by more information to the interpretation of the TEM pictures of the partially degraded biological objects.

2. In this moment the methods of the computer modelling, including the different kinds of presentations need no supplementary alterations or modifications. The complete representations of the points of symmetry, including the network proved to be necessary. But the points of symmetry without network seem to have a peculiar importance in the interpretation of the points of symmetry of the TEM pictures of the partially degraded biological objects. The results presented here in probably contributed to a better understanding of the very complicated biopolymer structures.

Acknowledgements

This work was supported by Grant OTKA 1/7 T 014692.

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KEDVES, M. and KEDVES, L. (1996): Computer modelling of the quasi-crystalloid biopolymer structure II. – Plant Cell Biology and Development (Szeged) *7*, 82–88.

12. LIST OF PUBLICATIONS OF THE LABORATORY UNTIL DECEMBER 1996

compiled by

Á. ERDŐDI

Cell Biological and Evolutionary Micropaleontological Laboratory of the Department of Botany of the J. A. University, H-6701, P. O. Box 993, Szeged, Hungary

ALVAREZ RAMIS, C., KEDVES, M., FERNÁNDEZ MARRÓN, T. y CLEMENTE BELMONTE, P. (1996): Estudio palinológico de un nivel rico en palinomorfos situado en el Barranco de Patones (Madrid). – XI Simposio de Palinología A.P.L.E., programa y resúmenes, Alcalá de Henares, 56.

HERNGREEN, G. F. W., KEDVES, M., ROVNINA, L. V. and SMIRNOVA, S. B. (1996): Chapter 29C. Cretaceous palynofloral provinces: a review; in: JANSONIUS, J. and MCGREGOR, D. C. (ed.), Palynology: principles and applications. – American Association of Stratigraphic Palynologists Foundation, Vol. 3, 1157–1188.

KÁROSSY, Á. (1996): List of publication of the Laboratory until December 1995. – Plant Cell Biology and Development (Szeged) 7, 98.

KEDVES, M. (1996a): Transmission electron microscopy of the fossil spores. – Szeged, ISBN 963 481 984 2.

KEDVES, M. (1996b): Plant microfossils from the Upper Cretaceous and Lower Tertiary layers of Northern Spain II. – Plant Cell Biology and Development (Szeged) 7, 13–36.

KEDVES, M. (1996c): Aspects and prospects of the TEM investigations of the fossil sporoderm. – Ninth Internat. Palynol. Congr., Program and Abstracts, Houston, Texas, U.S.A., 77.

KEDVES, M. (1996d): Trends and new aspects of experimental Palynology. – Ninth Internat. Palynol. Congr., Program and Abstracts, Houston, Texas, U.S.A., 77.

KEDVES, M. et GÁSPÁR, I. (1995): Altérations secondaires de certains sporomorphes sous l'influence des rayons X. Secondary deteriorations of some sporomorphs under X-ray influence. – 2e Symposium de Palynologie africaine, Tervuren (Belgique), Publ. Occas. CIFEG, 1995/31, Orléans, 255–259.

KEDVES, M. and GÁSPÁR, I. (1996): New data concerning the solubility of the pollen grains of the genus *Quercus* L. – Plant Cell Biology and Development (Szeged) 7, 56–61.

KEDVES, M. and KEDVES, L. (1996): Computer modelling of the quasi-crystalloid biopolymer structure II. – Plant Cell Biology and Development (Szeged) 7, 82–88.

KEDVES, M., PÁRDUTZ, Á. and VARGA, A. (1996): Ultrastructural Study on the Pollen – Microbial Interactions. – Taiwania *41*, 43–52.

KEDVES, M., SOLÉ DE PORTA, N. and MARTIN-ALGARRA, A. (1996): Spores and pollen grains from Eocene layers of Málaga Spain. – Plant Cell Biology and Development (Szeged) 7, 37–55.

KEDVES, M., TÓTH, A., KÁROSSY, Á. and VARGA, A. (1996): Molecular structures of the partially dissolved foot layer and endexine of *Pinus griffithii* MCCLELL pollen grains. – Plant Cell Biology and Development (Szeged) 7, 89–97.

KEDVES, M., TÓTH, A., MÉSZÁROS, K., BORBOLA, A., BENN, O. and GUBÁS, T. (1996): High temperature effect on the pollen grains of three varieties of cultivated maize. – Plant Cell Biology and Development (Szeged) 7, 62–74.

KEDVES, M. and UNGVÁRI, E. (1996a): X-ray effect to the LM morphology of some *gymnosperm* and *angiosperm* pollen grains. – Plant Cell Biology and Development (Szeged) 7, 75–81.

KEDVES, M. et UNGVÁRI, E. (1996b): Les types principaux des spores du Crétacé supérieur de Portugal. – XI Simposio de Palinología A.P.L.E., programa y résúmenes, Alcalá de Henares, 55.

TÓTH, A. (1996): To the 5th Anniversary of the official recognition of the Laboratory. – Plant Cell Biology and Development (Szeged) 7, 10–12.

UNGVÁRI, E. (1996): Chronicle. – Plant Cell Biology and Development (Szeged) 7, 99–102.

Chronicle

Compiled by

SZ. GAUDÉNYI

Visiting scientist

Dr. S. K. M. TRIPATHI Senior Scientific Officer (Birbal Sahni Institute of Paleobotany, Lucknow, India) worked in our Laboratory as visiting scientist under the Exchange of Scientists Programme between Indian National Science Academy (INSA) and the Hungarian Academy of Sciences. He worked here in Szeged from the 1st July until the 27th August. His scientific activity was focussed on the subject of the biopolymer structure and the symmetry operations of partially degraded walls of *Botryococcus braunii* isolated from Upper Tertiary Hungarian oil shale. The following manuscript was completed:

KEDVES, M., TRIPATHI, S. K. M., VÉR, A., PÁRDUTZ, Á. and ROJIK, I.: Experimental studies on *Botryococcus* colonies from Hungarian Upper Tertiary oil shale. This paper will be published in the next (9) number of Plant Cell Biology and Development, in 1998.

A photograph of Dr. S. K. M. TRIPATHI in the Cell Biological and Evolutionary Micropaleontological Laboratory. The picture was taken by Dr. É. SIPOS-KEDVES.

International laboratory activites

23–28 June, 1996, Houston, Texas, U.S.A.

At the Ninth International Palynological Congress, on the 27th June the following oral communication was presented:

KEDVES, M.: Aspects and prospects of the TEM investigations of the fossil sporoderm.

Another paper was presented by M. KEDVES on the 28th June as follows:

Trends and new aspects of experimental Palynology.

At the Ninth International Palynological Congress appeared the following book in three volumes:

JANSONIUS, J. and MCGREGOR, D. C. (ed.) (1996): Palynology; principles and applications. – American Association of Stratigraphic Palynologists Foundation. ISBN 9-931871-03-4. One hundred contributors worked on these excellently presented volumes. These volumes are of a basic importance of all laboratories working on palynological researches.

18–20 September, 1996, Alcalá de Henares, Spain.

At the XI Simposio de Palinologia, A.P.L.E. on the 19th September the following oral communication was presented by M. KEDVES:

KEDVES, M. et UNGVÁRI, E.: Les types principaux des spores du Crétacé supérieur de Portugal.

C. ALVAREZ RAMIS presented the following paper:

ALVAREZ RAMIS, C., KEDVES, M., FERNÁNDEZ MARRÓN, T. y CLEMENTE BELMONTE, P.: Estudio palinológico de un nivel rico en palinomorfos situado en el Barranco de Patones (Madrid).

23 September, 1996, Madrid, Spain.

At 12 a.m. M. KEDVES at the Universidad Complutense, Facultad de Ciencias Geológicas (Sala de Juntas) presented the following oral communication:

Les premiers palynomorphes d'Angiospermes parus dans l'Hongrie.

Until 27 September M. KEDVES worked in the Laboratory of C. ALVAREZ RAMIS on the paper:

KEDVES, M., ALVAREZ RAMIS, C., FERNÁNDEZ MARRÓN, T., CLEMENTE BELMONTE, P. and GOMEZ PORTER, P.: Pollen grains isolated from pre-Quaternary sediments of „Barranco de Patones", Spain.

Hungarian scientific activities

On the 16 April appeared the 7th number of Plant Cell Biology and Development.

The habilitations diploma of the Eötvös University, Budapest, Hungary was handed to Prof. Dr. M. KEDVES by Prof. Dr. M. SZABÓ, Rector of the University.

At the 1316th meeting of the Botanical Section of the Hungarian Biological Society on the 2nd December in Budapest, the following lectures were delivered by M. KEDVES:

Beszámoló a IX. Nemzetközi Palinológiai Kongresszusról (Houston, Texas, U.S.A., 1996. Június 23–28.).

Beszámoló az A.P.L.E. XI. Palinológiai Szimpóziumáról (Alcalá de Henares, Spanyolország, 1996. szeptember 18–20.).

09.02.1996. Preparations of the international scientific meetings for 1996 and 1997, speaker: M. KEDVES.
Compilation of the contributions for the 8th number of Plant Cell Biology and Development, speaker: M. KEDVES.
Discussion of the papers which will be published in international reviews, speaker: M. KEDVES.
01.03.1996. Discussion of the present day state of the 8th number of Plant Cell Biology and Development, speaker: M. KEDVES.
Preparations for the international scientific meetings of this year, speaker: M. KEDVES.
Other actual business, speaker: M. KEDVES.
22.03.1996. Symmetry in Chemistry I., speaker: Á. KÁROSSY.
The biological importance of the melanins, speaker: A. BORBOLA.
Other actual business, speaker: M. KEDVES.
19.04.1996. Symmetry in Chemistry II., speaker: Á. KÁROSSY.
Structure and function of the melanins, speaker: A. BORBOLA.
Other actual business, speaker: M. KEDVES.
22.05.1996. The following new middle school students became connected with the scientific program of the Laboratory: SZ. GAUDÉNYI, E. HORVÁTH, Á. KALMÁR, E. MÉSZÁROS, R. MÉSZÁROS, N. SZLÁVIK. As regards the research opportunities of the middle school students the acitivity of Dr. P. CSERMELY is worth of mentioning. In his edition an information prospectus appeared as the 5th number of the series of Cell Biological Who is Who, under the title: „Kutatási lehetőségek középiskolásoknak" (Research opportunities for middle school students).
21.08.1996. On the occasion of the 6th anniversary of the official recognition of the Laboratory there was an exclusive reception for all members of the Laboratory. Participants: A. BORBOLA, Á. ERDŐDI, SZ. GAUDÉNYI, E. HORVÁTH, E. MÉSZÁROS, R. MÉSZÁROS, A. TÓTH, Dr. S.K.M. TRIPATHI, and A. VÉR. Prof. Dr. M. KEDVES head of the Laboratory handed laboratory diplomas to A. VÉR and Dr. S.K.M. TRIPATHI.
29.08.1996. The Commemorative Medal of the Laboratory was handed to Prof. Dr. Á. PÁRDUTZ in the study of Prof. Dr. M. KEDVES at a very warm reception.
13.09.1996. The present day state of the papers in numbers 8 and 9 of Plant Cell Biology and Development, speaker: M. KEDVES. The research programs of the Laboratory until the end of this year, speaker: M. KEDVES.
Other actual business, speaker: M. KEDVES.
04.10.1996. Report from the Ninth International Palynological Congress (Houston, Texas, U.S.A.), from the XI Simposio de Palinologia, A.P.L.E. (Alcalá de Henáres, Spain) and the sojourn and scientifical acitivity in Madrid, speaker: M. KEDVES.
Other actual business, speaker: M. KEDVES.
08.11.1996. Discussion of the papers of the Laboratory publications, speaker: M. KEDVES.
On the problems of the participation in international joint research programs, speaker: M. KEDVES.
Preparing the international scientific meeting of 1997, speaker: M. KEDVES.

Plate 1.


INTERNATIONAL MAN OF THE YEAR
1995 • 1996

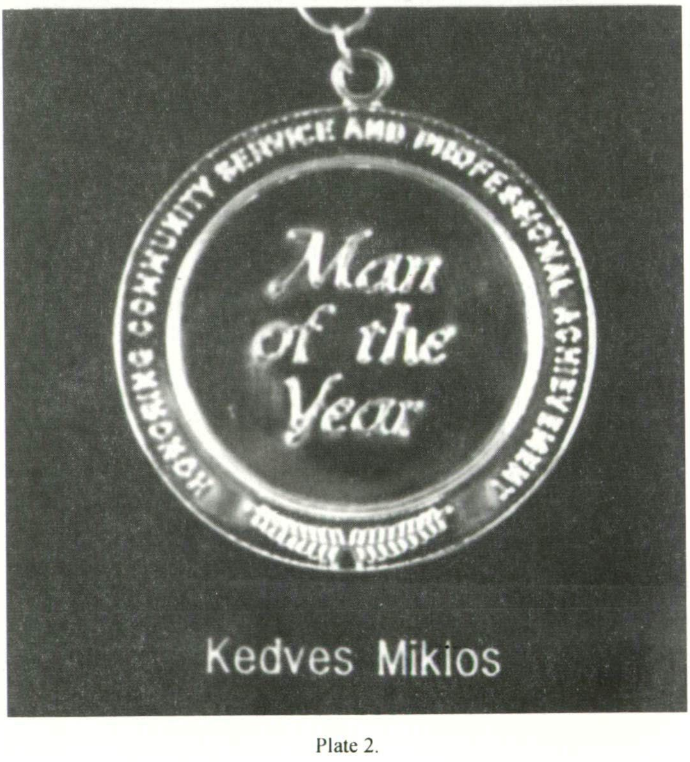
HONORING COMMUNITY SERVICE AND PROFESSIONAL ACHIEVEMENT
Man of the Year
Kedves Mikios

Plate 2.

The research programs of the Laboratory for 1997, speaker: M. KEDVES.

29.11.1996. The definitive compilation of the papers of the 9th number of Plant Cell Biology and Development, speaker: M. KEDVES.

Diapositive projections and report: Anaheim, Sequoia forests, California, Okefenokee, Georgia, Everglades, Florida, U.S.A., speaker: M. KEDVES.

Teaching program of the Laboratory

During 1996 the following lectures were delivered:

1. Biopolymer organization and symmetry of the plant cell wall, 1+2 hours weekly,
2. Basic and Applied Palynology, 2+2 hours weekly,
3. Theory of Evolution and its natural philosophical relations, 1 lecture weekly,
4. Basic Palynology, 2+2 hours weekly,
5. Ultrastructure of the plant cell wall, 1+1 hours weekly,
6. Basics of the supernova theory, 1 hour weekly.

Awards

Although the last year's medals of Prof. Dr. M. KEDVES were mentioned in the last number of Plant Cell Biology and Development (7), p. 12, here in this number are published the pictures of the Birbal Sahni Centenary Medal of 1995 (Plate 1, figs. 1,2), Lucknow, Uttar Pradesh, India.

Medals in 1996

International Man of the Year 1995–1996, silver medal. Donator: The International Biographical Centre, Cambridge, England (Plate 2, upper picture).

Man of the Year Commemorative Medal. Donator: American Biographical Institute, Raleigh, North Carolina, U.S.A. (Plate 2, lower picture).

Men's Inner Circle of Achievement. Donator: American Biographical Institute, Raleigh, North Carolina, U.S.A.

On the 27th August arrived the Fourth volume of the Five Hundred Leaders of Influence, and on the 6 November the Five Thousand Personalities of the World published by the American Biographical Institute. The biography of Prof. Dr. M. KEDVES was also included in these volumes.

Plate 1.

Both sides of the Birbal Sahni Centenary Medal of 1995 (Lucknow, Uttar Pradesh, India). The pictures were taken by Dr. I. BAGI.

Plate 2.

Upper picture. – Front side of the silver medal of the International Man of the Year 1995–1996 (The International Biographical Centre, Cambride, England).
Lower picture. – Front side of the Man of the Year Commemorative Medal (American Biographical Institute, Raleigh, North Carolina, U.S.A.). The pictures were taken by Dr. I. Bagi.

A. TÓTH finished her 10th semester at the Szent-Györgyi Medical University. Her ceremonial jogging was held on the 18 May at 10 a. m. The Laboratory was represented at this occasion by Prof. Dr. M. KEDVES, A. BORBOLA and Á. ERDŐDI.

Responsible for publicaton: M. KEDVES
Responsible editors: A. BORBOLA and A. TÓTH
Cover by Á. ERDŐDI
Set in New Times 10/11 point
Juhász Nyomda, Szeged

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